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OF
PRACTICAL MEDICINE

BY
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SAJOUS'S ANALYTIC CYCLOPEDIA of PRACTICAL MEDICINE

N

NEURASTHENIA.—DEFINITION.—A disease to which Beard, of New York, first called attention, in 1869, characterized by functional exhaustion of the tissues, especially those of the nervous system, due to excessive or undue waste of nervous energy, psychic or motor, and in some cases to autointoxication.

SYMPTOMS.—The salient symptom of neurasthenia is fatigue, or muscular weakness, often varying in degree with the duration of the case, but usually excessive and persistent. The patient complains of feeling "very tired" and of being unable to do mental labor, the least concentration being followed by vertigo, headache, etc. It is characteristic of this sense of fatigue that it is in simple and typical cases always relieved or lessened by rest, and always brought on, if absent, or made worse, if present, by exertion. According to Dercum this readiness of fatigue is the primary and fundamental symptom of neurasthenia. The patient often shows a remarkable diminution of strength, as shown by the hand dynamometer, or in lifting, even though he may be capable of exerting a sudden show of force. He is incapable of

sustained effort. Backache, probably a fatigue symptom, is often complained of. It is relieved by rest.

Of 300 cases coming with a diagnosis of neurasthenia, not one presented any of the symptoms emphasized 25 years ago. Only three symptoms were common to all, namely, lassitude, depression and a tendency to become easily fatigued. There had been some mental disturbance in 34 per cent.; some organic derangement in 40 per cent. In 6.66 per cent. simple debility was responsible. These individuals got along without disturbance in their usual sedentary routine, but under unusual physical stress the "neurasthenia" developed at once. In all cases an emotional factor, definitely traced in 25 per cent., was evident. J. Dejerine and E. Gauckler (*Presse méd.*, Feb. 26, 1913).

Soldiers in active service are subjected to all sorts of shock and strain; hence, many functional phenomena occur, *e.g.*, constriction of visual fields, amaurosis, aphonia, deafness, various forms of paralysis, etc. Some, after shock or strain, show essentially the symptoms of fatigue and abulia, the symptoms especially characteristic of true neurasthenia. Beside these essential symptoms, many others occur, which often lead to much confusion in diagnosis. Among these are vertical or posterior headache, increased by exertion, diminished by

rest. Hyperacousis is common, and may render music repugnant. Photophobia or diminution in the acuity of vision is often associated with fatigue. Neurasthenics are morbidly conscious of visceral movements and become morbidly anxious. Pains in the neck, back, or extremities may be very severe and defy all means of relief. Muscular tremors, especially of the facial muscles and eyelids are very common. The knee jerks may be decreased or normal, but more often increased. Testing the reflexes may give rise to more or less extensive disagreeable sensations or an emotional state. Col. H. T. Tooth (Birmingham Med. Rev., Nov.-Dec., 1917).

Another manifestation of muscular weakness is tremor. Short spasmodic contractions of isolated groups of muscular fibers and aimless movements of the extremities that suggest, when facial muscles are involved, chorea. The tendon reflexes, including the knee-jerk, are increased in the majority of cases. Fine muscular tremors are often observed, especially of the orbicularis oris and the lingual muscles. Most patients complain of trembling knees and shaking hands, the last symptom being often noticeable in the handwriting.

The headache, one of the most common symptoms, varies in intensity from a sensation of heaviness on the top of the head, or fullness, to a feeling compared by some patients to that which an iron band tightly constricting the head might produce. It is often occipital. This is especially marked after intellectual labor, and often disappears after the latter ceases. It may also be caused by muscular effort or an emotion.

The appearance of the patient does not always denote the existence of the neurasthenic state; indeed, his general mien may suggest perfect

health. In the majority of cases, however, there are pallor and an unmistakable appearance of weariness. Loss of weight and anemia are often present, and occasionally the physical debility is so great as to keep the patient in bed.

Insomnia is frequently complained of by neurasthenics, or the sleep is disturbed. If sound, the patient awakens unrefreshed and even more fatigued sometimes than when he retired. Dreams of an unpleasant kind are common; they sometimes reach the intensity of dreadful nightmare.

The mental disturbances of the neurasthenic may be summarized by the phrase "weakness and irritability." The capacity for work is reduced and the muscular power correspondingly so. Even thinking or reading, which involve the necessity of fixing attention, is irksome. Amnesia, general and verbal, weakness and indistinctness of speech, irritability, fretfulness, and hypochondria, sometimes reaching to melancholia and suicidal tendencies, are sometimes witnessed. Mental aberration is suggested by many petty acts which the patient in his normal state would not have perpetrated. Indeed, he may become tyrannical, envious, jealous, and even cruel. Curious perversions of mental activity are witnessed, mental pictures and various thoughts succeeding one another with rapidity, while a name, a sentence, a time, etc., will for hours and even days recur constantly to the patient's mind. Through a misinterpretation of his symptoms, he deems himself the victim of many diseases, while in reality suffering only from nosophobia.

Again, he may constantly be dread-

ing falls, especially when near an open space, such as the top of a staircase, or experience a sense of suffocation upon the least excitement or unusual incident of everyday life. Courage is very deficient, owing to the loss of psychic and motor power. The sudden appearance of a stranger or any unusual incident of daily life may thus incite intense fear, and give rise to dangerous manifestations, especially when an organic cardiac disorder is present.

Pain along the spine accompanied by localized spinal tenderness is often complained of. The upper cervical region near the occiput over the vertebra prominens, or again the sacrum and coccyx, are frequent sites of this pain. Lumbago, previously referred to, and various muscular pains suggesting rheumatism are frequent. In cases in which spinal symptoms predominate there is also marked muscular weakness—a symptom to which Charcot attached much importance,—and sometimes disturbances of co-ordination, the presence of locomotor ataxia being suggested. General paresis may also be simulated; indeed, when there is a history of syphilis the differential diagnosis sometimes becomes difficult.

Neurasthenia occurring under 20 is rarely neurasthenic. It is a dementia precox, or a recurrent melancholia, or the exhaustion of a phre-nasthenia, and it is rarely paranoia. Neurasthenia occurring at this early period with a bad family history, including family alcoholism, should make one very suspicious of a serious malady. C. D. Dana (Boston Medical and Surgical Journal, March 31, 1904).

Exaggerated knee-jerk, vasomotor reddening, tremor of the eyelids, tongue and fingers, and acceleration

of the pulse are considered objective indications of neurasthenia. In many hundreds of healthy persons the writer found each of them in from 25 to 65 per cent. of those examined. A pulse of 88 and over was evident in 37 per cent. of 1300; tremor of the eyelids in 64 per cent. of 524, and exaggeration of the knee-jerk in 65 per cent. of 800. None of these signs indicates neurasthenia, but when several are noted in one person instability of the nervous system is beyond question, but this does not necessarily mean neurasthenia. Schellong (*Zeit. f. klin. Med.*, Bd. lxxx, Nos. 1, 2, 1914).

Hyperesthesia of certain regions of the skin (Valleix's points) is sometimes noticed. Formications, evanescent sensations of localized heat and cold are occasionally complained of, though these sensations may be general, as are also the profuse sweating and the flushes of heat so frequently met with during the menopause.

Vertigo is often complained of; in some cases it is almost continuous and characterized by exacerbations, during which the patient may fall and suffer injury. Hysterical manifestations are frequent, especially in women, though true hysteria be absent.

Irregular action of the heart, palpitation, is usually noted, the pulse sometimes being very rapid—90 under ordinary circumstances, and from 120 to 160 during attacks of "palpitation;" apprehension, pain, and general distress in the cardiac region often result, increased by the least excitement, anxiety, or fit of temper. The pain in the cardiac region may be sufficiently severe to resemble an attack of angina pectoris.

Neurasthenic pains are generally improved by movement, contrary to the pain in true rheumatism and

arthritis. This applies also but less constantly to neurasthenic palpitations and pseudoangina pectoris. The patient generally jumps up and walks to and fro, during which the pain subsides. It is often accompanied by general restlessness, palpitations and sweating. Neurasthenics are generally extremely sensitive to heat and to constriction from tight collars. Kollarits (*Deut. med. Woch.*, April 21, 1910).

Throbbing of the arteries, including the aorta, carotids, peripheral arterioles, and even at times the capillaries of the nails, may be witnessed, the veins, at times, taking part in the manifestation. Still the extremities may be quite cold, the patient requiring heavy clothing to feel at all comfortable. This is due to weakness of the circulation, with reactive exacerbations that have been termed "vasomotor storms."

There is practically always in true neurasthenia a long prodromal period, the pre-neurasthenic state, characterized by well defined morbid manifestations indicative of aberrant functioning of the emotional centers.

The immediate cause of this instability is the reaction of environment on the patient's mind. This state is not actual neurasthenia, and may not develop into it, but neurasthenia is its culminating development. Neurasthenia is a definite syndrome which must not be confounded with the nervous asthenia of many neurasthenoid states that constitute the prodromal periods of various psychoses, result from the abuse of stimulants, drugs, or tobacco, or are symptomatic of organic diseases. Neurasthenia should be clearly differentiated from obsessions, hysteria, melancholia and hypochondriasis. The heart and the blood vessels are usually the first to reflect the central functional disturbance in neurasthenia. S. H. Bennett (*Practitioner*, February, 1918).

Visual disturbances are common, the symptoms suggesting astigmatism following any prolonged use of the eyes, which also causes headache and vague distress. The pupils sometimes appear unusually large and often unequal, while the accommodation seems defective. Unilateral ptosis is often observed. The eyes feel weary and heavy, and letters become blurred; flashes and pain are experienced in most cases after reading even a very short time—a few minutes. Examination of the eye reveals a marked readiness on the part of the accommodative apparatus and of the retina to become fatigued, slight rest affording considerable relief. Photophobia is sometimes sufficiently marked to keep the patient in a dark room.

As a rule the urine is scant and high colored, but this is often due to the fact that the patient, as is frequently the case with neurasthenics, drinks but little water. The urine is occasionally increased in quantity, owing to irritation of the kidneys through deficiency of water; this may also cause vesical irritation sufficient in some instances to suggest cystitis. All the fluid secretions, saliva, perspiration, and also the gastric intestinal secretions may be scanty. "Lithemic neurasthenia" is a term applied to a form in which, besides the other symptoms enumerated, manifestations of lithemia are marked. Phosphaturia, oxaluria, and glycosuria are frequently (14.4 per cent., according to Arndt) noted.

Sexual impotence is more or less marked and in some cases is total. Seminal emissions at night and during defecation and micturition may be frequent, and depression after

coitus is usually complained of. Masturbation as a feature of the past history of the patient is given by him an exaggerated importance as a cause of his neurasthenia. The testicles or ovaries may be extremely sensitive to pressure, a dull, heavy pain, quite persistent at times, being occasionally experienced. In women, nocturnal orgasms, followed by depression or even exhaustion, may be complained of. Pelvic pain may also occur.

Sexual neurasthenia is always due to definite pathological conditions in the genito-urinary tract. The lesions may be situated in any part of this tract. Because of the exceptionally rich supply of sensory nerve-endings in the prostatic urethra, the changes in this part, especially in the vicinity of the verumontanum, are most apt to give rise to this type. A. J. Underhill (Jour. Amer. Med. Assoc., June 14, 1913).

There are six types commonly called neurasthenic, but divisible into (1) neurosis or anxiety neurosis; (2) mild, rare or atypical psychosis, *e.g.*, manic depression, psychosis and dementia praecox; (3) incipient tuberculosis; (4) low grade cryptic infection; (5) early exophthalmic goiter; (6) cerebral arteriosclerosis. Neurasthenia should be considered as an abnormal, imperfect, inadequate type of reaction, expression or auto-erotic fixation; an infantile type of reaction in which the individual takes an undue interest in his own body, of which he is acutely and abnormally conscious. On these sensations he often erects a more or less organized system of false ideas (auto-erotic inversion). W. J. Mallory (Jour. Amer. Med. Assoc., Mar. 19, 1921).

Indigestion of the type called "nervous" is a common feature of neurasthenia. The digestion is enfeebled and delayed and is associated with atonic constipation, and gastralgia is some-

times complained of. The appetite is capricious and distaste for food may prevail. Hyperchlorhydria is sometimes observed, but as a rule the patient complains of loud, gaseous eructations, and delay in digesting his food, the latter "lying heavy" in the stomach. The gaseous distention may cause "palpitations," and epigastric and precordial distress. Gastropotosis is not infrequent.

Ancona and the writer have noticed that when they ask a patient to show them his tongue if he puts his tongue far out, *i.e.*, in such a way that the back of the tongue and throat are visible, further examination will almost inevitably reveal other signs of neurasthenia or a neurotic predisposition. Pancrazio (Gaz. degli ospedali, xxxiv, Nos. 140-142, 1913).

In severe cases, the gastric disorder is more severe. The eructations of gas become distressing, more frequent, and sufficiently forceful to be noisy. Meteorism, alternating constipation and diarrhea, colicky pains, due to defective intestinal digestion and the resulting fermentation, are prominent features of this stage. In such cases autointoxication is an important feature.

One is practically justified in diagnosing gastric neurasthenia when one has excluded all organic gastric disease and also finds the characteristic stigmata of general neurasthenia. The signs elicited upon a physical examination of the patient, and which will confirm the diagnosis, are the following: 1. One will probably be able to elicit the splashing sound (*clapotement*, *Magenplätschern*) during the whole of the digestive period, but the absence of food-residues from the stomach before breakfast will show that the severe form of myasthenia gastrica is absent. It is important to bear in mind that gastric plashing is absent in cases characterized by the presence of sensory neuroses only. 2. There are usually spots

painful on pressure in the upper abdominal region. There is not a single one, as in ulcer, but several, and these not so acutely tender. 3. No diagnostic information is to be obtained by the chemical examination of the gastric juice. Usually there is slight hypochlorhydria, occasionally hyperchlorhydria, and often it is quite normal. 4. Gastropptosis and nephropptosis are often present, and strongly suggest neurasthenia. The diagnosis is thus mainly to be made by a process of exclusion. George Herschell (Edinburgh Med. Jour., Jan., 1902).

In diagnosing neurasthenia, or the relative values of various phases of the condition, the bacteriologist's report of colonic findings should be taken as the starting point. The toxins produced by many colonic microbes, bacterial or protozoan, are definitely known to be injurious to the cells of organs, and those influencing the ductless glands abnormally are largely derived from bacteria of the colon. The surgeon can help in many cases by fixing the loose kidney, suspending the sagging colon, and separating adhesions that interfere with gastric or intestinal motility. R. T. Morris (Arch. of Diag., Jan., 1913).

Tinnitus aurium, hyperacousis (the patient starting at the slightest sound), and loss of taste also occasionally attend the more prominent symptoms. The patient may complain of unpleasant odors or tastes. Undue redness of the ears and conjunctiva are frequently observed. Heaviness and throbbing about the scalp, or a feeling as if cold air or water were circulating under it are occasionally complained of.

DIAGNOSIS.—Various *neuroses* and *psychoses* may readily be taken for neurasthenia when the symptoms of the latter are few and indefinite, but this is rare, and the characteristic

fatigue supplemented by the main symptoms that typify the affection usually render a diagnosis easy.

Hysteria may be confounded with neurasthenia, and both affections may exist simultaneously in some cases. The absence of crises, contractures, among other hysterical stigmata, serves to eliminate the disease as the primary one. It must be remembered, however, that hysteria is so commonly associated with neurasthenia that a special name, "hysterical neurasthenia," has been proposed for cases showing the combined syndromes. Such cases lack, however, typical manifestations of hysteria, viz., anesthetics, palsies, convulsions, and complete loss of self-control.

The criterion employed to distinguish hysteria is its susceptibility of production by suggestion and removal by suggestion or persuasion, as enunciated by Babinski. The latency of suggestion is shown and also its power to produce secondary neurasthenia, in the false gastropathics of Dejerine, and even the tics and obsessions simulating those of the psychasthenia of Janet. The criteria of the latter consist mainly of the relative absence of fatigue along with the presence of the particular stigmata such as morbid fear, chronic inadequacies, altered sense of reality, and episodic agitations of motor, intellectual, and emotional content. The psychogenetic origin of these distinguishes them from the similar complication of physical nature which may occur during an attack of neurasthenia. T. A. Williams (Arch. of Diag., Jan., 1909).

Locomotor Ataxia.—In neurasthenia reflex action is generally increased, while in the majority of organic affections of the system, including tabes, they are diminished.

General Paresis.—In this disease there is reduction of mental activity,

while in neurasthenia the intellect is not necessarily impaired and is over-active in many cases. Mental labor is practically impossible, owing to the subsequent untoward effects. When a history of syphilis is present, however, symptoms of general paresis may supervene in addition to those typifying neurasthenia. This is particularly to be suspected when articulation is impaired, or when the formation of sentences in writing becomes unusually difficult.

All the symptomatic indications which have been relied on to establish the differential diagnosis of early general paralysis from ordinary neurasthenia are utterly fallacious; cases are constantly occurring in practice where the decision as to which of the two diseases is present has to be left to time. The first positive signs of parietic dementia are in fact nothing else but true neurasthenia. The occurrence of neurasthenic symptoms as a preparalytic phase are extremely frequent, and perhaps constant, if our clinical histories are complete. Since the symptomatology of the two diseases shows that in both similar nervous centers are affected, while evidence is accumulating to support the theory that both diseases are due to some subacute or chronic intoxication of endogenous or exogenous source, it is probable that neurasthenia and general paralysis are intimately related, that neurasthenia is the curable stage of general paralysis. Petrazzani (*Riv. Speriment. di Freniat.*, vol. xxxiii, fasc. 2-3, 1907).

Neurasthenia in soldiers in active service shows the same symptoms as during peace. The specific features are impulsive ideas and phobias; even the entire sphere of consciousness may suffer. The existing conditions of warfare imprint special features on the neurasthenia. The forms with agitation show during periods of hot battling, while trench warfare elicits the more torpid forms of neurasthenia.

The physical symptoms also are the same as in time of peace, headache, dizziness, tinnitus and diminished hearing. Clavus, that is, an acute sharply localized pain, especially in the occipital region, is also very common, and hysteria is a frequent complication. Gerver (*Roussky Vrach*, xv, No. 11, 1916).

Exophthalmic goiter may also be confounded with neurasthenia, but only when there is no exophthalmos. The enlargement of the thyroid becomes the only reliable distinguishing feature, the rapid pulse, agitation, tremor, etc., being all present in neurasthenia.

Neurasthenia must be carefully differentiated from myxedema, myasthenia, and Addison's disease. In testing knee-jerk we often find the whole body thrown into a characteristic state of agitation. Gastrointestinal and metabolic derangement is common and indican and phosphates are usually present in the urine. Rennie (*Brit. Med. Jour.*, May 13, 1911).

The lymphocytosis is the same in Basedow's disease as it is in asthenic and neurasthenic diseases and many neuroses. It points to a disturbance of the lymphatic system, and of the thymus and blood-glands. Rudolf and Hoeslin (*Münch. med. Woch.*, June 3, 1913).

Hypochondria.—This disease being a form of melancholia, with illusions concerning the health, it is not under the control of the patient, whereas the neurasthenic is sufficiently master of himself to yield, if he is made clearly to understand, to an explanation of the source of his imaginary ills.

ETIOLOGY.—Heredity acts only as a predisposing influence through parental neuroses or psychoses. Gout, rheumatism, syphilis, and tuberculosis may also act as predisposing conditions in the offspring. Excesses

of all kinds, particularly in sexual relations, lower the resistance of the organism as a living entity (not only of the nervous system), and pathogenic factors find a fruitful field which, had not inherited depravity prevailed, would have proved sterile.

Individuals so predisposed represent by far the majority of cases witnessed. There is another class, however, in which the ever-increasing responsibilities attending modern methods of living, unrestrained extravagance, desire to promptly acquire wealth, and the worriment attending the responsibilities incurred, undermine metabolic dynamism, thus initiating the disease. If the victim of worriment can so change his occupation and his mode of living before the inroad of the malady is marked, a prompt return to health usually results.

In both classes the exciting conditions are similar; and sexual indiscretion, continued worry and overwork, shock accompanying injury, exposure, indiscretions in diet, improperly selected or insufficient food, and many diseases, particularly influenza, syphilis, typhoid fever, and such disorders as alcoholism, morphinism, cocaineomania, etc., tropical climates in which humidity is added to heat, will act as primary causative factors of the typical form.

Tropical neurasthenia is extremely common among Americans who go to the Philippines, men and women suffering with it after they have resided there a year or more. Women suffer almost invariably with uterine disease in connection with the neurasthenia; vasomotor disturbances of various kinds are also common. Tropical neurasthenia responds to treatment more readily than the ordinary kind, change of climate

being especially beneficial. Fales (Amer. Jour. Med. Sci., April, 1907).

In a study of postoperative and postanesthetic neurasthenias and psychoses, the total of patients examined was 344: women, 220 (or 64 per cent.); men, 124 (or 36 per cent.). Instances of neurasthenic or mental disorders following operation, or æsthesia, 31 (or 9 per cent. of the total patients examined); women, 29 (or 94 per cent. of the postoperative cases); men, 2 (or 6 per cent. of the postoperative cases). The operations in these cases varied widely, from the most trifling surgical intervention, such as ocular tenotomy, straightening of the nasal septum or dilatation of the cervix uteri, up to total hysterectomy and ovariectomy. The worst and most persistent examples of nervous disorder not by any means always followed the most serious operations. No doubt a certain constitutional or temperamental predisposition is required as a precedent, and one cannot make a rule excluding this as one of the causes, as one would in judging of purely traumatic neuroses. J. K. Mitchell (Amer. Jour. Med. Sci., July, 1911).

Neurasthenic symptom-complex observed in patients suffering from lead poisoning, more marked in the ambulatory forms of the disease. This manifestation of plumbism is one of the most common and is to be considered as a psychic form of lead dyscrasia. Samson Hirsch (Deut. med. Woch., Feb. 12, 1914).

In women, excessive fecundity, dysmenorrhea, and the menopause are thought to exercise a marked exciting influence. According to Peterson, the pelvic organs themselves play but a small rôle in these physiological commotions. They have to do with the whole organism of woman. Pelvic diseases in woman attended by exhausting pain may give rise to neurasthenic and hysterical states, but the influence of ex-

hausting pain in these organs is no greater than similar exhausting pain elsewhere in the body. Disorders of the female organs which affect the nutrition of the nervous system, such as excessive hemorrhage or suppurative processes, may also be important factors in inducing functional neurosis, though disordered blood-states brought about by pelvic disease are very infrequent as compared with disordered blood-states dependent upon disease elsewhere.

Of all causes those connected with the male sexual organ have been credited with the most active etiological rôle, especially localized disorders, prostatitis, posterior urethritis, seminal vesiculitis, etc., and general disorders and habits, such as gonorrhea, syphilis, and masturbation.

As to the influence of sex upon the genesis of the disease, an analysis of 333 cases by Joseph Collins and Carlin showed that 55 per cent. were males and 45 per cent. females. Statistics by Cleghorn, based on 6000 cases, showed the disease to be far more prevalent in men than in women. Hebrews and Slavs seem to be particularly predisposed to neurasthenia, but this view is probably to be ascribed to the fact that New York, in which these analytical studies were carried on, contains a very large proportion of individuals of these races who, owing to their poverty, apply to dispensaries for treatment.

Out of 37,564 patients who had applied for treatment in the neurological department of Vanderbilt Clinic during the eighteen years from October, 1888, to November, 1906, there were found 6000 cases of neurasthenia. From this list were excluded cases which had any definite

symptoms recorded of hysteria or insanity. No cases in children under 13 years of age were found which could not be attributed to the ordinary nervousness brought on by fright or poor environment, though some of them might have been found to be neurasthenic had they been followed up for a sufficient time. Of the 6000 cases thus remaining, 3516, or 58.6 per cent., were male and 2484, or 41.4 per cent. females. From his series the author shows that neurasthenia is much more frequent in men than in women. It occurs between the ages of 20 and 40 in two-thirds of the cases, few comparatively starting after 40. The indoor occupations furnish a large majority of all cases. Among causative factors, the disturbances of the gastrointestinal tract and the intoxications stand out as principals, and the most constantly present symptoms seem to be headache, insomnia, and constipation. Cleghorn (*Med. Rec.*, April 27, 1907).

Occupations which impose the necessity of remaining indoors, especially where considerable intellectual work is done, furnish a large proportion of cases. Lack of self-control in emotional individuals, musicians, for example, or frequent fits of anger, overtraining in colleges and other institutions of learning predispose and may even initiate the disease.

That the ductless glands play an important rôle in the genesis of neurasthenia is probable. If, as I have urged, the thyroid and adrenals (see *ANIMAL EXTRACTS*, vol. i) play an important rôle in oxidation and in protecting the body against auto-intoxication, any condition which exhausts these organs must necessarily impair the general dynamism and lower the vascular tension, the underlying causes of neurasthenia in most cases.

Lesions of the suprarenal glands may produce the phenomena which are common in neurasthenia. In its acute forms suprarenal insufficiency may take the form of pseudoperitonitis with sudden death, pseudotoxemia, pseudomeningitis, or pseudotyphoid fever, the diagnosis resting principally upon the two symptoms, asthenic and vascular hypotension. In the subacute and chronic forms there have been few reported cases, excepting those of E. Sargent and L. Bernard. In the paper of these authors the following symptoms are mentioned: 1. Circulatory troubles, including chilliness, small and unstable pulse, arterial hypotension, tachycardia, collapse, syncope. 2. Digestive troubles, including anorexia, vomiting, diarrhea, and peritoneal symptoms. 3. Nervotoxic troubles, including encephalopathy, headache, excitement, delirium, convulsions, depression, coma, asthenia, and acute pains. 4. Hypothermia, anemia, emaciation and cachexia, and cadaveric odor. E. Schneider (*Revue de médecine*, October, 1907).

Cases classified formerly as neurasthenics are due to disorders of the internal secretions. The depression of hypothyroidism, more particularly in older people is notable. In dysthyroidism there are peculiar recurrent states of neurasthenia, great prostration, and inability to concentrate; pituitary disorders, too, create neurastheniform symptoms. Insufficiency of the adrenals may also produce neurasthenia characterized by extreme asthenia, inability to think clearly and discouragement, as a rule with low blood-pressure. Tom A. Williams (*Med. Press*, Jan. 19, 1916).

The small proportion of cases in which heredity plays an active rôle usually appears during the transition between childhood and puberty—15 to 20 years, while those in which the acquired form obtains occur during the most active period of life: *i.e.*, between 20 and 50 years. It is es-

entially a disease of the period of life during which great exertion and anxiety combine to increase the wear and tear of the central nervous system, and indirectly of the organism at large.

PATHOLOGY.—Neurasthenia was until recently solely attributed to exhaustion of the nerve-centers presiding over general nutrition, and particularly of the brain and nervous system. Actual loss of substance in the protoplasmic cells, especially of the nucleus, has been noted by Hodge. Impaired metabolism, with accumulation of waste-products, which in turn accumulate in the blood, gives rise to an autointoxication affecting especially the nervous system, and the functions over which the various systems preside are correspondingly impaired. This is further encouraged by the continued waste of energy from which the patient suffers if he persists in imposing even slight tasks upon his weakened organism. A vicious circle of pathogenic activity is thus formed.

In all cases examined von Bechterew found that there were a considerable diminution in urea and an increase in the uric acid. The relation of the total nitrogen to the quantity of urea indicates a marked decrease in the intensity of nitrogenous oxidation. The relation of the uric acid and disodium phosphate indicates an increased secretion of uric acid. In many cases the condition of the patient improves coincidently with the diminution or disappearance of the arthritic phenomena. The changes in the urine are those characteristic of intestinal putrefaction.

Analysis of the blood in thirty-three cases of neurasthenia by Ro-

meister and Collins, revealed that many cases show a decreased ratio of leucocytes to erythrocytes. Nearly all had a more or less marked oligochromemia, often with many microcytes and a few poikilocytes.

If the disease persists any length of time there presently appears a condition of blood fairly constant and typical of the disease. The red corpuscles after a time resemble old cells. In many the cytoplasm in stained specimens seems pushed out to the periphery to such an extent that the cell becomes dumb-bell shaped instead of the normal lenticular or biscuit shape, and the cells pack together closely. The oxygen-carrying capacity is lowered, and in consequence the hemoglobin is deficient in color-test. The blood in neurasthenia, then, would seem to be poor in oxygen-carrying capacity, and the peripheral blood varies much in its character. C. H. Lodor (Jour. Amer. Med. Assoc., April 20, 1901).

PROGNOSIS.—Left to itself neurasthenia tends to persist, unless its cause, especially worry, excessive work, mental or physical, a debilitating habit, etc., be removed. There may occur periods of improvement, but relapses occur readily.

Under proper prophylactic measures and judicious treatment, however, the prognosis is usually favorable. Especially is this the case if the organic changes outlined have not had time to so undermine the functions of the organs secondarily involved—especially the stomach and kidneys—as to compromise their physiological functions in nutrition and elimination of waste-products.

The occurrence of symptoms recalling locomotor ataxia or general paresis and impairment of articulation, though alarming, does not necessarily indicate a dangerous condition. Indeed, unless

of too prolonged standing, they are sometimes the first to yield to appropriate measures.

TREATMENT.—Rest, mental and physical, distractions, nutritious—though easily digested—food, and removal of baneful influences as far as possible constitute the predominant features of treatment. Physical and mental rest, however, does not mean the total cessation of activity, but a reduction of the work imposed upon the organism as a whole, preserving for it sufficient dynamic stimulation to activate all vital processes. The slight increase in the action of the heart derived from a short walk, for instance, increases the efficiency of assimilation, and, as life is but the transformed energy of the food ingested, the primary factor of repair is thus assisted. Yet, undue exercise would, by inducing fatigue, bring about a contrary effect. Metabolism being deprived of a sum of energy corresponding to the excess of exertion imposed upon the organism, its activity would be reduced in proportion and all the symptoms exaggerated.

The writer emphasizes the importance of recognizing that proper treatment of neurasthenia can only be based upon the detection of one of the many causes which underlie the disease in a given case. In the one, excessive intellectual labor and emotional stress will have caused failure of his endocrines. The latter, compensated by judicious organotherapy, will soon recover and cause the neurasthenia to disappear. Genetic factors, hyperproteosis with raised blood-pressure, radiculitis of arthropathic origin, faulty occupational position causing pain, overnourishment to counteract a supposed breakdown, a cortical neoplasm, a phobia due to mental stress, jealousy, vagabondia, are illustrated by specific cases.

as among the various etiological factors which must be met specifically to cure the disease. T. A. Williams (Med. Rec., Apr. 23, 1921).

This suggests that all individuals should not be treated in the same manner, and that the just merits of each individual case should be taken as a guide. This is well illustrated by the fact that in some cases the disease is due to ocular defects. The **correction of eye-strain**, if any, is beneficial even if the disease be due to other causes.

Fatigue symptoms, unrelieved by refraction correction, and often associated with the so-called hysterical accommodation, may be due to special susceptibility of the eyes to outside irritation, either physical or psychical. These cases may be classified as ocular neurasthenics, though they seldom, at least in the stage when they come under the oculist's care, present symptoms of general neurasthenia. They occur usually among industrious people. Ephraim Woods (Jour. Amer. Med. Assoc., July 20, 1907).

The benefits of **rest** in the average case may be secured by spending four to six additional hours in bed, by retiring early and getting up late. Or, a couple of hours' rest during the day may replace the morning hours of rest if these are inconvenient. An outline of the course adopted by Weir Mitchell in severe cases will serve to illustrate the general principles of treatment. "On awaking in the morning the patient is to take a cup of cocoa, after which she is to rest for twenty minutes. She is then to get out of bed and sponge herself with cool water or be sponged by an attendant, after which she is to be rubbed dry with a coarse towel. She is then to dress leisurely, and lie

down for twenty minutes before breakfast; after which meal she is to lie down again for an hour, and rest absolutely. Massage [gentle] should be given at 10 or 11 in the morning, and this be followed by an hour of rest. She then takes a cup of strong soup or, preferably, milk. The patient may then go about and attend to any duties until luncheon; and after this meal rest is also to be taken. During the afternoon the patient may walk or drive and attend to business matters; but she should not exercise more than she can possibly help. If electricity be used, it is best given just before the evening meal or at bedtime. The patient should retire early." Men do not respond to the Mitchell rest cure. (see **REST CURE**, this volume) unless virtually bedridden.

In neurasthenia only the most gentle movements possible are to be performed; any irritating, so-called stimulating movements are to be prohibited. Any point that is tender or hypersensitive is the last that should receive attention. The actual nature of the **massage** movement performed is of minor importance, provided that it is rhythmical. J. B. Mennell (Pract., Jan., 1914).

All the phases of a drugless treatment are herein represented, each of which must be regulated to suit the patient's means and strength. **Traveling** is almost always useful, unless too arduous; the **changes of scene** greatly tend to alter the morbid trend of the mind. An altitude of over 2000 feet is too stimulating for these cases. The **sea-coast in a wooded country**, where fogs are infrequent, is usually very beneficial, especially if preceded by a **sea-voyage**.

Isolation is recommended by many writers when neurasthenia is accompanied by very marked symptoms of lowered nutrition and muscular weakness, and when a prolonged rest in bed is insufficient to arrest the emaciation. The other factors of the treatment here are **generous feeding**, selecting dishes relished by the patient, and **rest in bed**, the latter being necessary during the first six weeks of the complete treatment. **Over-feeding** is sometimes obligatory. It consists especially in the progressive administration, each day, of 3, 4, 5, and 6 pints of milk in divided amounts. Occasionally, at the end of a few weeks, one or two eggs a day may be added to the milk diet.

Electricity is extolled by many writers. As to the particular current to be used, no general rule can be laid down. Some assert that **static electricity**, together with other forms of electricity, is not only a tonic or sedative, but an eliminator of poisonous materials. It not only influences nervous action through the vasomotor system, but excites vital function by acting on the cell and its protoplasm, hastening nutritive changes and cellular activity; excretion is thus stimulated and poisons are eliminated—precisely the *desiderata* in neurasthenia.

Actinic rays are chemical in their quality, but of small caloric value. They exist mainly in the ultra-violet zone of the spectrum. Actinic rays derived from high-power electric lights are similar to or identical with those of solar origin. Their use is as rational as that of sunlight itself. Their value lies in their decomposing, but at the same time reconstructive molecular action on the body tissues, mainly the blood elements. By the method described by the author,

their activity is enhanced by the generation of ozone in free and nascent form. Their ultimate effect is one of oxidation, and consequently they increase the metabolic changes, thereby augmenting the natural processes of regeneration within the system. The germicidal action is especially pronounced on account of the fact that few germs can exist in the presence of free or nascent oxygen in either diatomic or triatomic form. A. E. Sterne (Jour. Amer. Med. Assoc., Feb. 20, 1904).

In many cases there is an alteration of the level of the blood-pressure from the normal, the level being sometimes higher and sometimes lower than the normal. In a very large majority of cases the application of **high-frequency currents** produces a lowering of blood-pressure, while the **static bath** (+ charge) and **massage** produce a raising of pressure. The discharging of a patient charged with static electricity results as often in a rise as in a fall of blood-pressure. The application of the faradic current tends rather to lower than to raise the blood-pressure, and the galvanic current cannot be said to affect much change in either direction. Macnamara (Lancet, July 18, 1908).

Hydrotherapy has also been highly recommended. In cases attended by severe dyspeptic symptoms Winternitz obtains excellent results from the following procedure: The patient is placed on his back and covered with a sheet well wrung out of cold water (from the armpits to the knees). Before covering this with a dry sheet, a coil of rubber tubing is applied to the epigastrium, through which a current of warm water at a temperature of 122° F. (50° C.) is passed. This procedure is employed for half an hour before each meal during a number of weeks.

The application of **cold over the**

spine is credited with marked efficacy by Kinnear, the bags being applied from the fourth to the last lumbar vertebra. A cold sponge along the spine when rising acts as a stimulant.

Insomnia sometimes requires active measures, but morphine, stimulants, and all agents capable of starting a "habit" should be strictly prohibited. The bromides are also pernicious in these cases, since they tend to retard metabolism. Trional, sulphonal, amylene hydrate, etc., have been recommended for the purpose, but the **hot pack** is far preferable.

Sleep is also favored by taking a **warm bath** of ten minutes' duration, followed by a glass of **hot milk** just before retiring.

Codeine has been praised. Its good effects cannot be due to its narcotic properties, considering the small dosage. In $\frac{1}{6}$ -grain (0.01 Gm.) doses, given thrice daily for four to five days, and later the same amount five or six times daily, it produces satisfactory effects. The dose can be decreased as soon as the patient improves.

Among the general remedies, **strychnine** still holds the first place. Beginning with $\frac{1}{60}$ grain (0.001 Gm.) three times a day, the dose should gradually be increased until the physiological effects of the remedy appear. The dose should then be slightly reduced, and the weaker dose continued persistently until recovery becomes assured.

Strychnine is almost a specific in neurasthenia. The writer gives it in increasing doses—always in excess of 6 mg. ($\frac{1}{10}$ grain) daily dose. By reason of the fact that strychnine is not retained in the body certain individuals can acquire a tolerance of several centigrams a day. In anxious

states this high dosage is not indicated and by the mouth $\frac{1}{10}$ grain daily dose need not be exceeded, while $\frac{1}{15}$ suffices by the hypodermic route. To give larger doses would very likely increase the severity of the anxious state. Hartenberg (Med. Record, Aug. 31, 1918).

Arsenic, iron, and other tonics are often valuable. Glandular products, **desiccated thyroid gland**, 1 grain of some American preparation, such as Armour's, which contains 5 grains (0.3 Gm.) of the fresh gland to the grain (0.06 Gm.), or **pituitary**, 2 grains (0.13 Gm.) three times daily, are very efficient. **Corpus luteum** in large doses is often effective in women.

When the patient complains of chilly sensations, cold hands and feet, lack of perspiration, irregular muscular pains, and physical inertia, without signs of heart weakness, ordinary treatment is greatly aided by small amounts of **thyroid substance**, 1 grain (0.06 Gm.) two or three times daily. Improvement in ten days; stop drug for a week, then resume, etc. 2. When there is constant restlessness, with sense of heat, bright eyes, shiny and moist skin, glossy hair, tremor, exaggerated knee-jerks, abnormal hunger, diarrhea and menstrual flow, and pulse 80 to 90, remedies such as **belladonna, hydrastis, thyroidectin, ergot, and bromides**, and **ice applications to thyroid gland** for half an hour three or four times daily, are likely to benefit. 3. Where the patient is abnormally fat, with constant gain in weight, lack of ambition, craving for sweets, and headaches, **pituitary** or **thyroid substance** (1 or 2 grains—0.06 to 0.13 Gm.—a day) often does good. M. Allen Starr (Med. Rec., June 29, 1912).

Respiratory exercises are very helpful. Overexertion must be carefully avoided. Exercise should be limited to the use of pulleys or dumbbells.

Systematic breathing exercises recommended as a kind of internal massage of the viscera, regulating the functioning of the liver, bladder, and bowels, besides the influence on the respiratory organs. The main feature of the writer's exercises is that the deep inspiration and deep expiration succeed each other without any pause, and thus there is no stationary congestion in the parts. Knopf (Med. Klinik, April 23, 1911).

All disorders, primary or secondary, should be treated, those of the digestive apparatus particularly (see STOMACH, DISEASES OF), but in the majority of cases improvement of the general health causes disappearance of complications. **Aperients** are important to counteract the autointoxication resulting from constipation.

The body forms poisons within itself, which may be found in the urine, bile, venous blood and in the arterial circulation itself; these poisons are taken up from the gastrointestinal tract, and are constantly in the process of being excreted by the various emunctories. In healthy men the outgo equals the amount formed, but in the presence of pathological conditions, especially of the intestinal canal, the latter becomes a veritable culture-tube and absorption takes place.

Eight personal cases of neurasthenia attributed to intestinal troubles and cured by corresponding measures. There was a hereditary taint and neuropathic susceptibility. There was fear, in its various phases—so common in intestinal diseases. There was constant condition of intestinal putrefaction that had to be overcome before any relief was achieved; this was in many of the cases associated with insufficient elimination of urine. T. J. Orbison (Amer. Jour. Med. Sci., April, 1908).

It is important in this class of cases to gain the patient's confidence and

to recognize his infirmities rather than persuade him that many of them are imaginary. The endless complaints and fault-findings of neurasthenics are symptomatic. **Psychotherapy** in these cases is usually effective. **Sympathy** and **consideration** gain for the physician the patient's confidence and insure his co-operation in the curative measures instituted.

Series of cases of neurasthenia in which treatment consisted in first winning complete confidence of the patient, then in educating the physical body to do more than it had ever done to attain perfect tone, in order that the mind and nervous system might follow the body in regaining control and balance. The patient was **fed regularly**, and then **ample exercise** was taken in the **open air** to consume the entire intake of food. A thorough **evacuation of the bowels**, artificially produced, if necessary, was always insisted upon, every morning. **Exercise** morning and evening to the point of physical tire, but not exhaustion, was continued, and as the muscles hardened the depression and neurasthenia diminished. Gradually self-confidence was acquired, hopefulness in the possibility of cure became established, and after months of such treatment cure resulted. R. N. Wilson (Amer. Jour. Med. Sci., Feb., 1908).

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NEURITIS. See NERVES, PERIPHERAL, DISEASES OF.

NEURITIS, OPTIC. See OPTIC NERVE AND RETINA, DISEASES OF.

NEUROMA. See NERVES, PERIPHERAL, DISEASES OF.

NEUROMYOSITIS. See NERVES, PERIPHERAL, DISEASES OF.

NEURONAL.—Neuronal (brom-diethylacetamide; diethylbromacetamide) is a bromine compound of diethylacetamide $[\text{Br}(\text{C}_2\text{H}_5)_2\text{CO.NH}_2]$. It occurs as a white, crystalline powder, having a camphoraceous odor and a bitter, cooling taste, freely soluble in alcohol, ether, and oils, and in about 115 parts of water. Dose, $7\frac{1}{2}$ to 30 grains (0.5 to 2 Gm.).

PHYSIOLOGICAL ACTION.—According to Liebert, Becker, and others, neuronal produces quiet slumber about thirty minutes after its administration, with no unpleasant after-effects. It is asserted that the drug has no cumulative action. Stroux ranks it in efficiency and dose with trional, veronal, and chloral hydrate, but considers it preferable to these drugs because of its lower toxicity. The sleep induced is quiet and natural and the patient awakes refreshed and without headache. Stroux found that less than 15 grains (1 Gm.) does not act in the majority of cases; 45 grains (3 Gm.) were well tolerated; the highest daily dose employed by him was 53 grains (3.5 Gm.), which did not produce any ill effects.

THERAPEUTICS.—This drug is used as an hypnotic and in cases of **excitement** of the **nervous system**. Restlessness associated with **cardiac disease**, **arteriosclerosis**, and **hemiplegia** was observed to be favorably influenced, and even **tabes**, **neuralgia**, and other conditions accompanied by severe pain were benefited (Bleibtrau).

Since neuronal contains 41 per cent. of bromine, Stroux tried it in a number of cases of **epilepsy**. It lessened the number of fits and improved the psychic condition of the patient, though in 1 case it had to be discontinued on account of extremely severe headache.

Its use has been suggested by Bleibtrau in **pertussis**, on account of its bromine content. In senile dementia, catatonia, and maniacal insanity its action is not satisfactory. W.

NEWBORN, DISORDERS PECULIAR TO.—Since the first month of life exacts the greatest toll of deaths, it must be accepted as the most dangerous period. Approxi-

mately $\frac{1}{10}$ of all babies born die in the first four weeks of their existence. This is attributable to two conditions: (1) That the newly born are immediately subjected to influences which are inimical to health, and (2) that the diseases of the newly born are just beginning to be better understood and more scientifically treated.

In spite of aseptic methods in the parturient period, the mortality and morbidity of infants' lives have been only slightly lowered. Malformations, birth injuries, and various forms of asphyxia are responsible for the deaths in the first few days, while to the infections must be attributed the great majority of deaths after the first week. This appalling death rate will be lowered when this period of relative immaturity is more closely studied, when obstetric operations are made by those who are especially competent, and when asepsis will be more rigidly carried out during at least the first two weeks of life.

[Schwarz states that taking care of the health of prospective mothers and preparing them physically and mentally for their task of nursing and raising their offspring are the first and the most important steps in the conservation of infant life. At present only a small percentage of expectant mothers receive proper attention during gestation, and every year thousands of mothers and babies die or are permanently injured whose lives and whose health could have been preserved by reasonable prenatal care.

By attention to hygiene, eclampsia is often avoided; at other times the early recognition of the pre-eclamptic stage, as expressed by change in the urine, increased blood-pressure, headaches, disturbed vision, and edematous swellings, may enable the physician to prevent the outbreak of the convulsions. The importance of pelvimetry and of exact obstetrical diagnosis, arranging for delivery

in safe surroundings and providing for competent nursing, is part of prenatal care.

Inadequate obstetrical training and insufficient control by State boards of health of the persons engaged in obstetrical practice, and the ignorance of the general public regarding the means by which childbearing can be made safe and comfortable, are largely responsible for the present deplorable state of affairs.

The factors at work to bring about a betterment of conditions are improvement in obstetrical teaching; establishment and extension of obstetrical dispensaries; attempts to impart much-needed information to expectant mothers through the missionary educational work of prenatal nurses, and through the publications of the United States Children's Bureau.]

PHYSIOLOGICAL PECULIARITIES OF THE NEWBORN.—The disorders of the newly born will be better understood if one keeps in mind the physiological peculiarities of this period which make the infant so susceptible to attacks of disease. That there is an undeveloped heat-regulating apparatus, especially in the immature, should be kept in mind. Both sudden cooling or undue high temperature will produce deleterious effects.

The change to pulmonary from placental respiration, if not normally accomplished, leads to lung collapse, or asphyxia. The respirations are normally rapid, 30 to 50, at birth, and irregular in frequency and force. The pulse rate differs little from that of the fetus, approximately 130. Over the heart it is not uncommon to note a systolic murmur in the early weeks of life. The urine, which at first is seen to be clear, becomes cloudy and often remains so for several days. Evidences of what were formerly interpreted as pathological kidney conditions are now known to be physio-

logical; in other words, it is not at all uncommon to find epithelial and hyaline casts and nuclealbumin in approximately one-half of all the newborn.

A brick-dust sediment not uncommonly appears about the third or fourth day of life, consisting of urates. This is the result of a deposit of uric acid or its salts which takes place in the kidney tubules.

As a basis for the calculation of the proper end of gestation fetal maturity is safer and more certain than the menstrual history, the date of a known coitus, or the date of quickening. Fetal maturity, although fundamentally bound up with organic perfection, is in reality associated with reasonably stable objective characteristics the most important of which are the length, the weight, and the head diameters.

As soon as the weight of the child passes 4000 Gm. the difficulties of labor tend to become serious. This may readily apply two weeks before term, or exactly at the fortieth week.

The most conspicuous features of maturity must be sought in the perfection of the various organs, the length and weight of the fetus, and the diameters of the fetal head. The child's length and weight and some of the diameters of the head are the only characteristics which can be determined by external measurement and therefore those upon which a diagnosis of maturity *in utero* can rest. Fortunately they are sufficient. C. B. Reed (Surg., Gynec. and Obstet., xxx, 589, 1920)

ASPHYXIA NEONATORUM.

DEFINITION.—By asphyxia neonatorum is understood that condition which results when the first respirations are not sufficiently well established to be involuntary and to support life. When the respiratory center is prematurely stimulated in the fetus,

attempts to breathe are made which often result in asphyxia.

If the placental blood-supply is deficient or absent, or if the circulation of the mother is unusually weak, due to heart or lung disease, asphyxia may also result. It is most apt to occur in breech presentations. More rarely the condition is one of the accompanying symptoms of congenital heart disease, or of intracranial birth lesions.

SYMPTOMS.—Two distinct forms, which, however, must be regarded as merely different *degrees* of asphyxia, are observed.

Asphyxia cyanotica or **livida** applies to the infant who is cyanotic at birth, and makes little or no attempt at respiration. The respiratory act, if made at all, is shallow and ineffectual; an occasional noisy, gasping effort may be made. The features appear puffed, and the eyes almost closed, but there is no loss of muscular tone, and the reflexes are not abolished.

If no relief is obtained from the mechanical obstruction due to mucus, meconium, or amniotic fluid, which prevents the air from entering the lungs, the second form, or **asphyxia pallida**, follows. The heart's action becomes markedly enfeebled, and the face shows the pallor of death. Unlike the first degree, the muscle tone is lost, the reflexes are abolished, the sphincters relax, and the cord becomes almost pulseless and soft.

PATHOLOGY.—There is general visceral congestion, especially in the lungs, liver, and brain; the right side of the heart and its veins are engorged, and mucus, meconium, or fluid may be found in the air passages or in the stomach, as the result of

respiratory efforts. The pathological picture is not unlike that found in death from immersion.

TREATMENT.—In the *livid form* the cord is not to be tied until pulsations can no longer be felt. Clear the air passages from any obstruction by mucus, and in such a way as to prevent aspiration of the latter. **Stimulate** the infant until it cries, using **artificial respiration** if the respirations are sluggish and intermittent.

If the *pallid form* is present, vigorous and heroic measures must be taken to save life. **Cut and tie the cord, clear the upper respiratory tract, and stimulate by alternate immersion in hot (104° to 108° F.—40° to 42.2° C.) and cold water.** If the results obtained are still unsatisfactory, persistent efforts for the induction of **artificial respiration** should be made.

The writer lays stress on the value of the **hot bath** in pale asphyxia and urges that in these cases a cold bath is absolutely fatal. H. Roberts (Med. Record, Aug. 26, 1911).

In passing the **catheter** the writer passes the little finger down the pharynx, so as to plug the esophagus, and then passes the catheter with a stylet. He would not teach Schultze's method to midwives. He found it advantageous to place the child in **hot and cold baths alternately.** Sir Francis Champneys (Med. Record, Aug. 26, 1911).

Sylvester's method is to be preferred to that of Schultze, as it is less apt to do damage to the infant.

The writer used **adrenalin** in the resuscitation of a newborn child after death of the mother from pulmonary embolus. After Cesarean section and rapid delivery of a child, the latter passed through the livid stage; the heart sounds could not be heard, and to all appearance it was dead. The

Schultze and other methods failing, although maintained for 40 minutes, he injected adrenalin solution 1:1000 **into the stump of the cord**, carrying the point of the needle well through the abdominal wall. In about 2 minutes he noticed that the cord began to pulsate, and heart sounds could be palpated and heard, and 10 minutes later with the aid of artificial respiration the child was breathing well and crying lustily. Mack (Jour. Amer. Med. Assoc., Aug. 28, 1915).

The pale cases are frequently not asphyxiated at all, but suffer from shock due to injuries to viscera and internal hemorrhages. To **intubate the larynx** he used a No. 6 catheter and gripped the larynx externally between the finger and thumb. Schultze's method sometimes severely injures children by causing hemorrhages into the lungs. Good results follow **oxygen**. Herbert Spencer (Med. Record, Aug. 26, 1911).

Laceration of the tentorium was found at autopsy in 47 infants among 667 born at the Kiel maternity. Delivery had been instrumental in each of the laceration cases and the children had all been asphyxiated at birth; only 2 could be revived and these died the second day. The writer insists on the peculiar dangers of the swings of the Schultze method when the child already shows symptoms of brain pressure. Bauereisen (Münch. med. Woch., May 7, 1912).

The writer recommends **dilating the sphincter ani with the fingers** to excite respiration when there is apparent paresis of this function in the newborn. C. W. Hunt (Charlotte Med. Jour., June, 1914).

DeForrest's method commends itself as simple and more effective, since it combines the advantages of heat with artificial respiration. This method is described by its originator as follows (Medical News, Sept. 9, 1905): Hold the head of the child between the thumb and in-

dex finger of the right hand placed on each side of the neck, with the baby's head to the right and lying upon the back. The baby's right or further arm is grasped well in the axilla between the index and the middle finger of the same hand; the ring and little fingers are to be extended as far down the spine as possible to give the back support. The left hand holds the legs of the child, from underneath, by grasping the thighs, and with the index finger between the thighs for better security and control. With the child held in this manner it is at once immersed in the tub of hot water, which should be of as high temperature as can be well borne, and held so that merely the face is out of the water. Expulsion of the air from the chest is then easily effected by flexing the thighs well over on the abdomen with the left hand, making firm counterpressure upon the back with the right hand to prevent the nostrils from being depressed below the surface of the water. Inspiration is next secured by overextension of the legs, and of the neck, supporting the back with the fingers of the right hand, as above described. The usual rhythm is, of course, maintained.

The writer's method consists in taking a breath of **oxygen** and then one of **air**, and then, by **mouth to mouth insufflation**, breathes the oxygen into the child's lungs, stimulating breathing by the reflexes from time to time. He has been successful in 3 very severe cases. In one of these he kept up the insufflations for two hours and three-quarters. Cavazza (Jour. Amer. Med. Assoc., Jan. 9, 1909).

The first movement should be one of expiration, to get rid of foreign matter. **Sylvester's method** is the one most taught in England be-

cause it is easier to learn than Schultze's, the latter method being badly taught even in textbooks. Inflation is much inferior to artificial respiration because it does not stimulate the heart. For pale asphyxia the writer advocates **warm baths**, and he gives as a criterion for diagnosis between pale and blue asphyxia the following: If the finger is grasped by the child when introduced into its mouth the condition is blue asphyxia; if not, pale. Thomas Wilson (Med. Record, Aug. 26, 1911).

Direct insufflation of the lungs by the mouth to mouth method is mentioned only to be condemned, since the act is likely to produce emphysema.

A very satisfactory method of treating asphyxia in the newborn. After delivery of breech the **child** should be immediately **inverted** and held in that position until respiration becomes deep and regular. If there is any evidence of foreign material in the throat the **pharynx** should be **gently stripped** in the direction of the **chin**, the **oropharynx** swabbed with gauze or wet cotton, and the **contents of the nose squeezed out**. Catheterization of the larynx is rarely necessary. A **few sharp slaps on the buttocks** will usually aid the desired result. If the condition is more serious, as evidenced by the general cyanosed appearance of the child and by the diminished heart action, which can be most readily ascertained by placing the finger on the cord, it should be separated from the placenta in order that the movements may be less restricted. The child must be kept warm constantly by **immersing in hot water** or **wrapping in hot towels**. While in the tub, **Sylvester's method** may be resorted to. Removing the child at intervals and **sprinkling its body with cold water**, powerfully stimulates respiration. **Mouth to mouth insufflation** may be practised by resting the back of the neck on the edge

of the tub and supporting the head with one hand, while pressing on the epigastrium with the other. Only the first of the expired air is to be used and the nose should not be compressed but left entirely open, in order that there may be free passage for any excess of air injected. **Laborde's method** may be used by an assistant at this time. The hypodermic injection of **ether, camphor, or whisky** is beneficial at times. W. A. Morgan (Bull. Lying-in Hosp., N. Y. C., June, 1908).

The writer holds the **child** first **prone** and then **supine** in each hand **alternately**. It is advantageous to begin by making a **single insufflation**. The objection to Laborde's method is that it leaves the tongue sore and unfit for sucking. Buist (Med. Record, Aug. 26, 1911).

Case of partial asphyxia in a newborn child showing no attempt at normal respiration, in which **prompt manual loosening and delivery of the placenta** and, as advised by Fitch, **exposure of its maternal surface to the air** improved the color. The **placenta** was **washed with warm water** to free it of blood-clots. Whenever the child becomes cyanosed turning of a stream of **oxygen on the placenta** caused immediate recovery of color. After thirty-five minutes of placental respiration the cord was tied and cut, and the child subsequently breathed normally. Freund (Med. Record, Feb. 11, 1911).

Carrel, of the Rockefeller Institute, has perfected an apparatus for **direct insufflation**, the pressure being controlled by a manometer.

Recently the **pulmotor** has been tried in maternity hospitals with success, and it will undoubtedly form a part of the equipment of the best-regulated institutions.

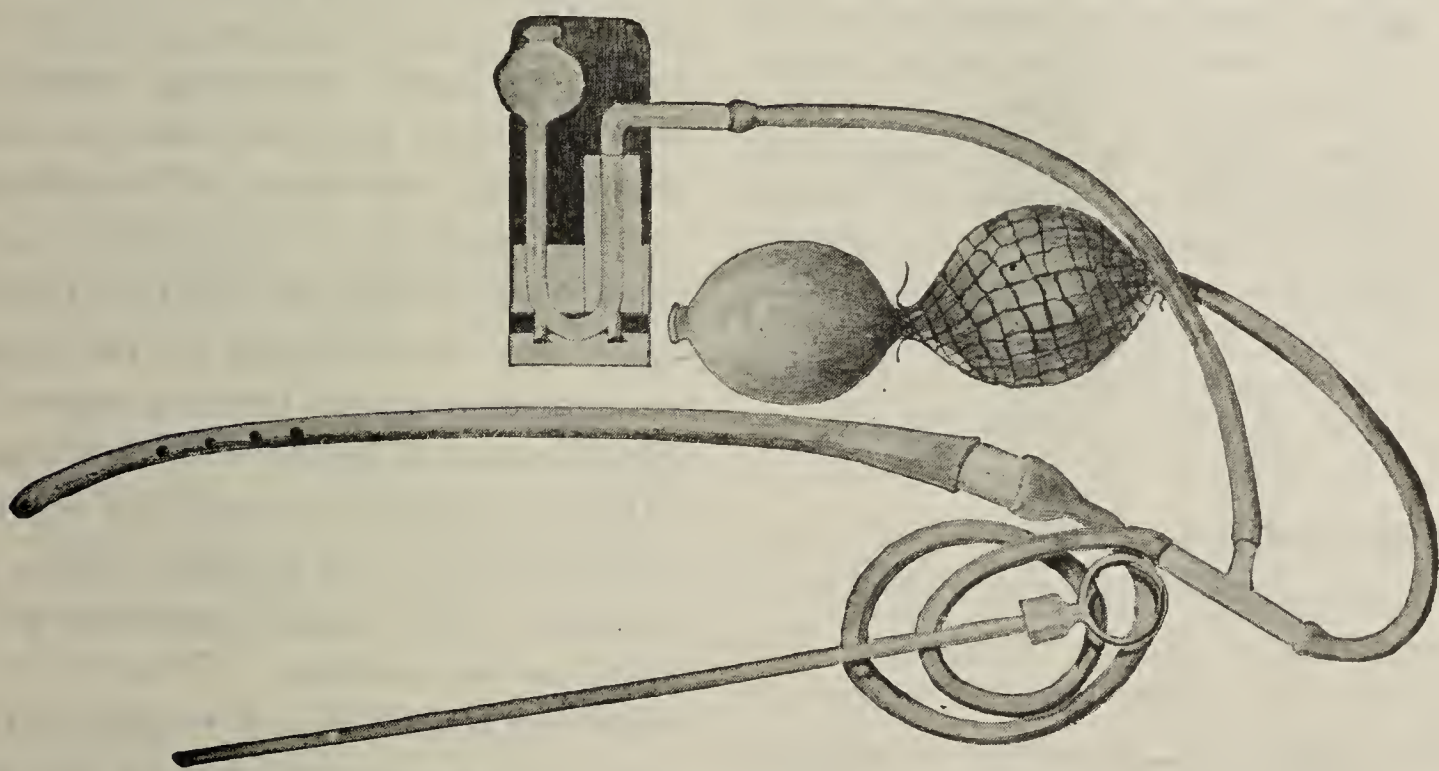
Success is not achieved until the respiration is voluntarily continued over several hours without any periods of remission.

Heart massage as an aid to resuscitation of stillborn infants is best carried out with the infant lying upon its back in a wide basin filled with sufficient water at a temperature of 110° to 120° F. (43.3° to 48.8° C.), to completely cover the body, the head supported so that no water can enter the mouth or nose. Using both hands, grasp the body of the infant in such a manner that the thumbs rest upon the anterior surface of the chest, the fingers extending across the back, as in the Schultze

facial respiration efforts. Of course, the efforts would be in vain if the infant had been dead too long, or if, after starting the heart, normal respiration could not be established. E. LaRue (Pediatrics, March, 1914).

CONGENITAL ATELECTASIS.

DEFINITION.—This condition is characterized by the non-inflation of the fetal lung, in whole or in part. It occurs most frequently in feeble, immature infants, who have not the



Carrel's apparatus for insufflation of the lungs.

method of artificial respiration. The thumb of the left hand should cover the third intercostal space almost against the left border of the sternum, while the right thumb is placed over the fourth intercostal space directly in the mammary line. Now make deep pressure, first with the right thumb, which forces the blood out of both ventricles; from the right ventricle through the pulmonary artery to the lungs, and from the left ventricle through the aorta to the arteries of the body; then with the left thumb, causing both auricles to contract and forcing their blood into the ventricles. This alternate pressure should be made at the rate of one hundred per minute, until the heart is distinctly felt to beat of its own accord; then it is safe to start arti-

ability properly to expand the lung. The lower lobes, posteriorly, are the region most commonly so affected.

DIAGNOSIS.—The diagnosis is oftener made from the symptoms than from the physical signs. The percussion note, however, is somewhat impaired over the collapsed area, and on auscultation the breath sounds are feeble, and accompanied, occasionally, by fine, moist râles. In some cases the healthy lung obscures any definite physical signs.

The diagnosis may be made if, in addition to the signs enumerated, there is cyanosis which is not constant, in an infant with a feeble cry,

having cold extremities, and with a subnormal temperature.

The absence of physical signs in the presence of pulmonary symptoms should be the chief guide to our diagnosis, coupled with the parturient history. As pulmonary symptoms should be included, 1, absent or feeble cry; 2, refusal to or feeble effort at nursing; 3, constant sleep. These 3 symptoms frequently obtain in the absence of cyanosis and labored breathing, the infant suddenly developing convulsions or dying from decarbonization of the blood, several weeks after birth—the diagnosis of atelectasis not being made unless the case reaches the autopsy table. The autopsy findings with ante-mortem histories of such cases first impressed upon the writer the relation between these symptoms and the atelectatic lung. G. G. Mack (Jour. of Surg., Gynec. and Obstet., Mar., 1908).

PROGNOSIS.—Attacks of cyanosis and prostration may occur after several days of improvement. The prognosis is poor, success being attained only by energetic treatment coupled with constant, skilled supervision.

TREATMENT.—The production of a good vigorous cry is a necessity. This can be accomplished by **mechanical stimulation** in the form of **spanking**, or **alternate hot and cold douches**, and the repetition of these stimuli if the child does not from time to time give a strong, vigorous cry. Frequent **change of position** and **careful feeding**, and maintenance of an **equable temperature**, are necessary.

Hot and cold baths to the chest in **alternation** are also useful, but the most practical treatment, and the one which is contraindicated only when convulsions have developed, is the **spanking**. When convulsions develop, **oxygen** is the better remedy,

given in connection with **artificial respiration** and **hot immersion baths**. G. G. Mack (Jour. of Surg., Gynec. and Obstet., March, 1908).

In "blue asphyxia" the writer particularly recommends **mouth-to-mouth insufflation**, using a **mucus aspirator**, with which he says that he is able to resuscitate all cases of "blue asphyxia." For combating "asphyxia pallida" he recommends the American-made **lung motor**. J. O. Arnold (Amer. Med., Sept., 1915).

INANITION FEVER.

This term is applied by Holt to a group of cases, occurring usually in the first five days of life, in which there is an elevation of temperature due to partial or complete starvation—this in spite of the fact that the child has been placed at the breast. An ample, copious feeding causes the temperature to drop. Physical examination is negative, except for restlessness, dry lips and tongue, and a hot, dry skin. The usual duration of the fever is three days.

DIAGNOSIS.—A temperature chart, and a weighing before and after feeding, will assist in the diagnosis.

PROGNOSIS.—The prognosis is good when the condition is recognized and a sufficient feeding is given.

TREATMENT.—A change to a **wet-nurse** with full breasts (who has passed a physical examination), or if this is impractical **artificial feeding**, should be resorted to. Attempts should be made by **rest and diet to increase** the amount of the **mother's milk** before this is entirely abandoned.

BIRTH INJURIES.

The newborn child may sustain injuries during its birth as a result of abnormal placental blood-supply or from compression of the cord, but most of such injuries are the result

of *disproportions between the child and the birth canal*. Assistance rendered by the physician or attendant at birth and forceps operations are responsible for many of the injuries. Williams gives an infantile mortality of 60 per cent. in high forceps cases. The operation of version, next to the forceps, is responsible for many accidents, such as fractures, hematmata, meningeal hemorrhages, atelectasis, and pressure paralyses.

Study of 23 cases of intracranial hemorrhage in the newly born, 18 of which were fatal. The writer used frozen sections, and found that these hemorrhages, instead of being arterial, as is usual in adults, were venous almost without exception, that they were almost always subdural, between the dura and the pia, almost never in the brain substance, and rarely in the ventricles. The infratentorial hemorrhages are particularly dangerous, and, so far as his observation goes, are always fatal. They come from small lacerated veins which open into the transverse or neighboring sinuses. The amount of blood is usually slight, little if any over a teaspoonful. When the transverse sinus is lacerated the hemorrhage is much greater and death is immediate. The danger from these slight hemorrhages in this place is due to the pressure on the medulla oblongata and the center of respiration. Seitz (Münch. med. Woch., March 24, 1908).

In examining 151 newborn infants the writer found ocular lesions in 37, or 24.5 per cent. These were paralyses, lesions of the cornea, and lesions of the retina. He also observed 1 case of exophthalmos, 1 of nystagmus, 1 of chemosis, and 1 where there was an abnormal persistence of myelin fibers. The cases of paralysis were those of the seventh pair of cranial nerves, and in 1 case the sixth pair. Lequeux (Arch. mens. l'obstet., Feb. 1912).

Details of 33 cases in which laceration of the tentorium, the cause of hemorrhages in this region, occurred. Since it has been sought more systematically, it has been found more frequently, being marked in 6 of the last 15 infant cadavers examined. It is liable to occur at any birth, while the danger increases proportionately with difficult delivery; the danger of laceration does not lie in the prolongation of the birth, but in the traction to which the head is subjected, stretching the falx cerebri in the lengthwise direction of the skull. Pott (Zeit. f. Geburts. u. Gynäk., Bd. lxix, Nu. 3, 1912).

Intracranial bleeding in the newborn following rupture of the tentorium may be favored by improper methods of protecting the perineum, if too great pressure be made against the perineum at the time of labor. In 1239 labors there occurred 8 deaths from rupture of the tentorium, probably caused by violent or sudden manipulation and unnatural pressure upon the head in efforts to prevent laceration of the perineum. Benthin (Monats. f. Geburts. u. Gynäk., Bd. xxxvi, Hft. 3, 1912).

CAPUT SUCCEDANEUM.

This fairly common condition, occurring as the result of compression during the act of parturition, consists in the production of a doughy mass with edema over the parietal or occipital bone; it is made up of an infiltration of serum and blood between the periosteum and the scalp. Without any special treatment the tumor is absorbed after a few days.

CEPHALHEMATOMA.

This consists of a rounded mass, usually developing about the second or third day on the cranial vault as a result of a subperiosteal hemorrhage. The overlying skin is movable and slightly edematous; more rarely there are seen pressure areas or evidences

of hemorrhage. The sense of fulness on palpation soon subsides and fluctuation can be made out. Characteristic of this type of injury is the fact that it never passes beyond the limits set by the sutures of the bone (due to adherence of periosteum at sutures). A ring of newly formed bone tissue develops about the base of the tumor, which gives the impression of a crater-like opening. As the blood absorbs, the periosteum becomes more closely approximated to the cranial bone. The time of absorption is variable, from a few days to several weeks. There is little evidence left except a thickening of the periosteum after healing has taken place. If suppuration has developed, however, due to infection, abscess formation results and the other added symptoms of general sepsis appear. Locally, the neighboring cellular tissue is involved; in some cases the denuded bone is affected.

DIAGNOSIS.—A *traumatic meningocele* can be distinguished from cephalhematoma by the fact that it can be reduced by pressure, and that it fills when the child cries.

PROGNOSIS.—There is a tendency to restitution in all cases; even in those which become infected life need not be endangered if active treatment is applied.

TREATMENT.—Under a **protective dressing** made in the form of a sterile cotton ring and gauze cap, the tumor subsides in the majority of cases. When the mass is large and difficult to control, **incision** and **drainage** can be practised. Good results will be obtained if **strict surgical cleanliness** is followed, with **shaving of the head**, etc., as a preliminary procedure. *When suppuration is*

present, as shown by heat, pain, redness, and swelling, one should **incise** at once and apply **moist antiseptic dressings**.

MUSCLE INJURIES.

The sternocleidomastoid muscle is peculiarly liable to injury at birth. Evidence of such injury appears after several days in the form of a fairly hard tumor, generally in the sternal part of the muscle. Usually the chin rotates toward the healthy side. This condition is more apt to occur in breech than in vertex presentations and is the result of rupture of the fibers, or of hematoma formation from undue traction on the muscle.

PROGNOSIS.—This is good as a rule, the tumor rarely persisting after the second month.

TREATMENT.—**Massage** three times a day will assist in the absorptive process. We have found light **vibratory massage** of great assistance. *In neglected cases* firm, **passive movements** to the unaffected side, with the body fixed, will relieve the torticollis.

BIRTH PARALYSES.

These are either *cerebral*, *spinal*, or *peripheral*. Certain causes at parturition may produce any one of these forms, viz., prolonged, dry or tedious labor, instrumental deliveries, breech extractions, and premature delivery. Fortunately spinal paralyses are extremely rare; such injuries cause various forms of paraplegia, the symptoms differing according to the location of the area of the cord involved.

CEREBRAL PARALYSIS.

SYMPTOMS.—The symptoms necessarily vary with the amount and location of the hemorrhage. A small extravasation may produce a fleeting

hemiplegia, while a copious bleeding will result in a stillborn child. Stupor, with shallow, irregular respirations, is noted. If convulsions follow, the lesion probably involves the motor areas. Since the meninges rarely escape, symptoms and signs such as are commonly found in involvement of the membranes are observed, viz., opisthotonos, Kernig's sign, nystagmus, spasticity of muscle groups, or complete flaccidity of the body. The fontanelle may be found bulging, due to extravasated blood, and this is a valuable indication for lumbar puncture.

ETIOLOGY.—In addition to the causes mentioned under the general heading as common to all forms of birth paralysis, there may have occurred bleeding in the brain, as in "hemorrhagic disease of the newborn," but the great majority of the accidents are due to the tardy or inexperienced application of the forceps. That syphilis may be a predisposing cause cannot be denied, but the fact remains that many infants, particularly the first-born, are permanently injured at birth, and those surviving the injury appear later with the end-results,—hemiplegia, spastic paralysis, and various grades of mental deficiency, as a result of brain degeneration or sclerotic changes.

PROGNOSIS.—Many of the cases are fatal, death occurring in a few days after birth. Smaller hemorrhages may show no harmful results until later in the child's life, when evidences of cortical degeneration appear. Mild cases may go on to complete recovery, leaving no trace of the injury.

TREATMENT.—It is evident that only by exercise of proper judgment

in the application of the forceps, and by inducing lung inflation as soon as the child is delivered, can avoidance of this injury be hoped for.

If the symptoms are definite, and especially if blood is obtained by lumbar puncture, **operative interference**, as has been advised by Cushing and more recently by Simons, should be considered rather than to allow irreparable damage to take place. The risk is more than justifiable in the face of the mental deficiency which so often results from these birth injuries.

The operation of Simons commends itself owing to its simplicity. A $\frac{3}{4}$ -inch incision is made through the suture and dura $1\frac{1}{2}$ inches to the right of the median line, to allow escape of dark-red blood. The procedure is repeated on the left side, a tissue drain inserted, and the skin closed. **Cushing's operation** may still be resorted to if this simpler operation is unsuccessful.

FACIAL PARALYSIS.

SYMPTOMS.—When the infant is asleep the paralysis is not noticed except for the eye on the affected side, which may be partly open. During nursing or when crying, however, the palsy is apparent, the muscles being drawn to the side of the face not affected. In the rarer instances due to a central hemorrhage the muscles of the lower part of the face are affected, while the sphincter of the eye is not disturbed.

ETIOLOGY.—This form of *peripheral* paralysis is almost always due to pressure of the blades of the forceps on the seventh cranial nerve at or about the stylomastoid foramen. Undue pressure being made on one

side only, the paralysis is also unilateral.

DIAGNOSIS.—*Hemorrhage into the meninges* can cause a form of central paralysis, but the extremities on the same side will also be involved unless the bleeding has been very slight and localized.

PROGNOSIS.—Recovery usually takes place spontaneously within the first two weeks.

TREATMENT.—Washing the eye on the affected side with **boric acid solution** to remove foreign bodies and prevent infection is usually all that is required.

OBSTETRICAL PARALYSIS (Erb's Paralysis).

SYMPTOMS.—The paralysis is usually noticed during the first or second day, the arm hanging limply with the hand generally rotated inward. Movements of extension are possible, but the power to flex is lost. Partial atrophy results from disuse.

ETIOLOGY.—This form of peripheral paralysis results from injury to the brachial plexus. As was mentioned above, most cases occur in breech deliveries, due to the necessity for traction. The fifth or sixth cervical nerves are usually injured. The deltoid, biceps, brachialis anticus, and supinator longus muscles are almost invariably affected.

Most cases result, not from pressure on the plexus, but from traction on it. If the axis of the head is drawn away from the long axis of the body by 30 degrees the cords of the plexus are stretched to the danger point. This is liable to happen in vertex presentation to hasten the delivery of the shoulder, and in breech presentation to hasten the delivery of the breech. It may also happen in extraction by forceps, and

in spontaneous birth the delivered head, by its own weight, may cause traction on the plexus. P. Bailey (Bull. Lying-in Hosp., N. Y., March, 1908).

PROGNOSIS.—The tendency is toward recovery, especially in the milder types of involvement. Improvement begins about the end of the first week and should be completed by the third month.

General practitioners commonly fall into the error of stating that nothing can be done for brachial plexus paralysis. Much depends upon the time when the treatment is begun, and the kind and character of the treatment employed. The earlier attention is directed in assisting nature in its reparative processes, the better able are we to re-establish a normal condition. By patient, persistent treatment, although sufficient damage is done to the trophic nerves at the time of birth to affect the muscles of the arm and the osseous structures about the shoulder-joint, we may still obtain an arm that will be practically normal in its range of motion. Frauenthal (Amer. Jour. of Obstet., April, 1912).

TREATMENT.—Stubborn cases will require active, systematic treatment to prevent a permanent paralysis of the deltoid. **Massage** coupled with the **faradic current** and **passive movements** will do much to prevent disability. **Nerve suture** must be considered in cases which have resisted treatment and show no tendency to a return of functional ability.

In brachial birth paralysis the principle of **bridging nerves** is of service by allowing scar tissue to take the place of the catgut strands commonly employed. To this end the nerve junction was carefully lifted on two fingers, the nerve-sheaths having been previously split up for a considerable distance above and below, and with a fine sharp

tenotome the nerve-fibers constricted by the cicatricial bands were thoroughly dissociated. Cargile membrane was then applied loosely and the wound closed. The return of function, which followed was almost startling in its rapidity. The theory that the regenerating axis-cylinders will use the strands of degenerated

side of the lesion. The deep cervical fascia, the nerve-sheaths, the nerves, and small accompanying vessels are torn; and after a time the resulting blood-clot and torn structures form a dense cicatrix, which prevents nerve regeneration. The paralyzed muscles fall into groups according to the roots injured. The



Erb's form of obstetrical paralysis.

nerve-fibers and scar tissue as bridges on which to extend themselves, similarly to vines on wire, certainly seems sound, and it only remains to prove or disprove this theory in actual practice. The writer urges a thorough trial of this method. Osterhaus (N. Y. Med. Jour., Nov. 7, 1908).

In brachial birth palsy (Erb's type), the essential factor consists in the forcible separation of the head and neck from the shoulder on the

characteristic attitude is one of extreme marked inward rotation of the whole extremity, which is accentuated by the pronation of the arm and hand. The prognosis is bad, as there is usually some degree of deformity and paralysis which persists. Operation gives the best prospect for a useful arm, and the best time for operation is as early as the general condition of the patient will permit (three to twelve weeks). In the cases where roots have been torn

from the cord these must be laterally implanted into the **neighboring roots**, or, if the latter have been damaged enough to require resection, all the **distal nerve-trunks** may be **sutured** in a bunch to the proximal roots still attached to the cord. After operation the head and shoulder must be held in approximation by a **steel brace**. After-treatment must be systematic and persistent. A. S. Taylor (Amer. Jour. Med. Sci., Dec., 1913).

INTESTINAL TOXEMIA.

This is a clinical entity which is rarely fatal, but not uncommon. It was described in, and has gained recognition through, a monograph by Morse.

SYMPTOMS.—An abstract of the symptomatology and diagnosis has been given by Morse (Amer. Jour. Dis. Children, Oct., 1912), as follows: A baby that was normal at birth and has continued to seem normal and to do well up to the second, third, fourth, or even fifth day becomes rather suddenly ill. He is likely to cry and moan considerably. Attacks of cyanosis are a common and early symptom. Twitching of the extremities, slight general rigidity, and retraction of the head come on in many instances, while convulsions are not infrequent. The temperature is, as a rule, only moderately raised, but may be high. In more severe cases the baby refuses to nurse. Vomiting is uncommon. In most instances there is no diarrhea, but a tendency to constipation. The symptoms develop before the baby ceases to pass meconium. If the stools are not composed of meconium, they are usually small, loose, dark brown and contain small, soft curds and mucus, often offensive. Loss of weight is generally rapid, the face becomes pinched, and the baby is

seriously ill. If the bowels are thoroughly cleaned out, all food stopped for a time, and water given freely, recovery is usually rapid and complete.

DIAGNOSIS.—The diseases for which this condition is most likely to be mistaken are cerebral hemorrhage the result of injury at birth, meningitis, hemorrhagic disease of the newborn, and septic infection of the newborn.

The diagnosis from *septic infection of the newborn* is the most difficult. The symptoms appear earlier, as a rule, than do those of septic infection, and the temperature is usually lower than in sepsis. There is no local nidus of infection, and marked general and local symptoms of infection, such as hemorrhages, deep jaundice, and furuncles, are absent. There is a tendency to constipation and the stools are usually meconium-like in character.

Hemorrhagic disease of the newborn can be excluded on the absence of hemorrhages.

Meningitis is extremely rare at this age and, when it occurs, it is a part of a general septic infection. There is almost invariably bulging of the anterior fontanelle in meningitis and usually when there is a *cerebral hemorrhage*. There are usually symptoms of focal irritation in hemorrhage and often blood in the nose and nasal pharynx, while in both cerebral hemorrhage and meningitis there is likely to be spasm of the extremities and exaggeration of the knee-jerks. A lumbar puncture will settle the diagnosis at once in a doubtful case.

ETIOLOGY.—The condition is attributed to a bacterial infection of the meconium, by way of the mouth or anus, on the first or second day

after birth. The evacuation of the intestines being incomplete, the toxic products formed in the meconium are absorbed into the circulation, and cause the symptoms. That it is not analagous to the *inanition fever* previously described is shown by the fact that intestinal toxemia occurs in infants that have had a full feeding, and that stopping the food or evacuating the bowels cures it.

TREATMENT.—Bowel irrigation and catharsis with **castor oil**, **stopping** of all food for twelve to twenty-four hours, and the substitution of plain **water** are advised. **Breast milk** is best after the period of starvation, or **fat-free cows' milk with a high percentage of milk-sugar**. The latter is recommended to change the bacterial flora.

ICTERUS NEONATORUM.

This is a common affection. A mild form of it is seen in many infants, otherwise in good health, soon after birth. Cruse found it in 84.4 per cent. and Holt reports it in 83.3 per cent. of all births. The commonly seen yellowing of the skin, due to the intense congestion observed soon after birth, without discoloration of the conjunctiva, is too benign to deserve consideration here.

SYMPTOMS.—The designation *true icterus* is applied to those cases in which the skin has been stained by the bile pigments. This occurs most frequently in premature or feeble infants born asphyxiated. It is usually not noticeable until the second or third day. The face is first affected and later the skin of the body. The urine remains free from bile pigments, but microscopic examination reveals masses of dark pigment

known as the *masses jaunes* of Parrot and Robins (Cruse showed these to consist of bilirubin).

This type of jaundice seldom lasts more than from seven to ten days. An icterus that persists beyond this time is probably one of the more serious forms, and constitutional symptoms will supervene, if they have not done so already. In this milder form there are few or no toxic symptoms. The infant is apt to be sleepy and takes less interest in nursing, and the pulse is not slowed, as in the adult forms of jaundice.

Icterus is not present at birth; it usually develops on the second or third day, increases in severity for two or three days, and then rather rapidly disappears. There is no rise of temperature in uncomplicated cases and the general condition is unaffected. The liver and spleen are not increased in size. The stools are not light colored and contain bile pigment.

The urine does not, as a rule, show the presence of bile pigments by the ordinary tests, although they are sometimes present. The probable explanation of the fact that bile is not found in the urine is that the urine of the newborn contains only traces of the alkaline phosphates which are necessary for the solution of the bilirubin. Morse (Boston Med. and Surg. Jour., Feb. 24, 1910).

DIAGNOSIS.—This must be made from the more serious forms, which may be due to congenital malformation, sepsis, or syphilis. Fortunately these forms are rare. Their distinguishing characteristics follow:—

Septic Type.—The infant shows constitutional involvement. The portal of entry is usually the umbilicus, although the bile itself may carry the infective agent. The child is seriously ill and the temperature is high,

the jaundice persisting beyond the second week.

Malformations.—Jaundice due to congenital obliteration of the bile duct or malformation of the gall-bladder, with or without cirrhosis of the liver, is fatal. The jaundice may not appear until the second week, varying in intensity from time to time. The fecal discharges are clay colored and offensive; the urine contains bile pigments, but no urobilin. The spleen enlarges with the liver, accounting for the prominence of the abdomen. Spontaneous bleeding occurs in some of the cases, and usually hastens a fatal ending.

Syphilitic Type.—Jaundice accompanying other evidences of syphilis makes the outlook particularly grave. The jaundice is usually present at birth and is quite intense. Hemorrhages from the skin or mucous membrane may occur, and unless vigorous **antisiphilitic treatment** is instituted early the infant fails steadily. The Wassermann reaction will clear up a doubtful case.

Familial Jaundice.—This is a rarer form which is characterized by the appearance of icterus in successive children of the same parents. A profound jaundice, developing rapidly, appears within a few hours of birth. The infant sinks into a lethargic condition and may have convulsions before the fatal ending is ushered in. Those who recover suffer from a prolonged and resisting anemia. This type is very fatal; Auden has reported 8 deaths out of 31 cases.

ETIOLOGY.—That jaundice may be hematogenous in origin is hardly tenable in the light of recent researches. It has been proven experimentally that jaundice cannot be in-

duced if the liver has been extirpated (Minkowski and Naunyn), nor has free hemoglobin ever been found in the circulating blood of the newborn. The author has had occasion to transfuse whole blood into infants, and jaundice has never followed. Clinical evidence rather bears out the researches of Knöpfelmacher, who holds that the bile-capillaries are blocked by tenacious bile, which, being unable to flow out, gets into the bloodstream.

[Hess (Amer. Jour. Dis. Children, May, 1912) made a *study of icterus neonatorum by means of the duodenal catheter* and found that bile is very rarely excreted during the first twelve hours of life; it was obtained but once in the course of 52 tests. Bile excretion during the subsequent twenty-four hours, he finds, is variable; in cases of marked jaundice it is profuse; in cases not jaundiced it is scanty or absent. The function of excretion gradually becomes fully established during the first week or ten days of life.

Where jaundice manifests itself, it precedes the excretion of bile into the duodenum. Secretion of bile varies within wide limits. In general, it is marked when the jaundice is marked. The occurrence of jaundice results from a defective correlation of excretion and secretion. It is generally caused by the inability of the rudimentary excretion to cope with the sudden profuse secretion of bile.

There has been too little consideration of the interrelation of secretion and excretion. The former may be said to be more important, for in some cases in which there is but slight secretion the rudimentary excretory function suffices to prevent the manifestation of icterus. The reason why jaundice appears in the first days of life is because, at the time when excretion has completely assumed its function throughout the body, a sudden flood of bile is poured into the passive excretory ducts and gains access to the hepatic circulation. G. R. PISEK.]

Disintegration of the mother's blood passing into the fetus causes



Syphilitic Form of Icterus Neonatorum.

icterus neonatorum. Wagner showed that the destruction of the maternal blood proceeds mainly in the placenta.

After delivery, the spleen and the rest of the reticulo-endothelial system assume the task. The placenta contains relatively much more iron at a premature birth than at term, and jaundice is almost inevitable in the prematurely born. B. Schick (*Zeit. f. Kinderheilk.*, Jan. 18, 1921).

dren of the same parents, between whom may have been born other children who were healthy or only slightly affected by icterus. There appears to be no difference between the mild form and the so-called physiological icterus of the newly born. There are transition forms between the mildest and the most rapidly fatal forms of icterus neonatorum. The etiology is unknown. Syphilis has been demonstrated in no case. Other infections are improb-



Tetanus in the newborn, showing trismus.

TREATMENT.—In the milder forms of jaundice, practically no treatment is required, while in the cases due to congenital malformations no treatment is of any avail.

In the form associated with syphilitic hepatitis the early injection of **neosalvarsan** may save life. It should be repeated at least once, and then followed by the older forms of treatment,—1 grain (0.06 Gm.) of **gray powder** three times a day, supplemented, if necessary, by **mercurial inunctions**.

Icterus gravis of the newly born has been very often met with in chil-

able. The apparent causes found in solitary cases are mentioned. For treatment he recommends the **promotion of diuresis**, subcutaneous infusions of **salt solution**, **warm baths** with **cold sprinkling**, **enemata of chamomile tea**, and anything else indicated by the symptoms. Pfannenstiel (*Münch. med. Woch.*, Oct. 27, 1908).

TETANUS NEONATORUM.

Tetanus is an acute infection characterized by violent muscular spasms, usually affecting, besides the great muscles, those of the jaw.

SYMPTOMS.—These usually begin about the fifth day, and rarely

after the second week. The infant is markedly fretful, and soon a disinclination to nurse is noticed. Closer examination will reveal that this inability to nurse is due to a stiffness or rigidity of the jaws, *i.e.*, *trismus* is present. The body is next involved, and the head thrown back, with short periods of relaxation; tonic convulsive movements may end in complete rigidity. If any relaxation occurs, handling brings on a renewed spasm. The temperature increases as the exhaustion progresses.

ETIOLOGY.—The infective agent usually gains entrance through the umbilical wound, or through skin abrasions on the body of the infant. The soil in certain sections of Long Island, particularly in association with stables, affords the medium for inoculation in a marked degree. The disease very rarely occurs in an urban population.

PROGNOSIS.—This is one of the most fatal diseases of infancy, the mortality being probably about 95 per cent. Fatal cases rarely live more than forty-eight hours. The later the phenomena appear, the better the chances. Death takes place from embarrassment of the respiratory muscles and exhaustion.

TREATMENT. — **Prophylactic.** — **Aseptic dressings and handling** should be carried out until the umbilical wound is thoroughly healed. Local **antiseptics** should be applied if any signs of suppuration appear after separation of the cord.

General.—**Antitetanic serum** should be administered at the earliest possible moment, to neutralize the toxins. Roux recommends that half the dose be injected into the subdural space by means of lumbar puncture, while the

other half is given subcutaneously. Unless the toxins can be neutralized and prevented from injuring the nerve-cells, the treatment will be of no avail.

Full doses of **potassium bromide** and **chloral hydrate**—2 grains (0.12 Gm.) of chloral and 5 grains (0.3 Gm.) of bromide every three hours by rectum—should be given. Except for **nasal feeding** and medication the **infant must not be disturbed** in any way.

Case in which the **tetanus antitoxin** was injected in the vicinity of the umbilicus at first, the next day subcutaneously and the third day half subcutaneously and half intramuscularly. The total dosage was 300 units. **Chloral** was given by the rectum, 0.5 Gm. (7½ grains) as the daily dose. This is larger in proportion than the maximum dose for adults; one day this dose was given at each of the three feedings. **Feeding** was possible only **through the stomach-tube** with the child under the profound influence of the chloral. The eighth day no chloral was given, only 0.5 Gm. (7½ grains) **bromide**, but the **chloral** had to be resumed again the next day in order to feed the child. By the eighteenth day the dose had been gradually reduced to 0.25 Gm. (4 grains) chloral and by the twenty-seventh day natural feeding could be resumed and all drugs were dropped. The child recovered rapidly and seems normal. Wolff (Deut. med. Woch., Sept. 11, 1913).

OPHTHALMIA NEONATORUM. (See page 563 in volume iii.)

PEMPHIGUS NEONATORUM.

This is a disorder affecting newborn infants, contagious in character, and occurring often in epidemic form.

SYMPTOMS.—The first indications of its presence are punctate red macules, which soon enlarge. Formation of vesicles then begins. These

are apt to open before reaching their full size, a distinct areola forming about them, with a denuded skin surface when the vesicles burst.

The contents of the bullæ are a yellowish liquid. The lesions are apt to appear synchronously or in widely scattered crops. The principal regions affected are the abdomen, inguinal regions, and axillæ; occasionally the mucous membranes of the mouth and lips are involved. The scalp is usually spared. A secondary infection sometimes causes suppuration in the bullæ.

In the milder cases the general condition of the infant is only slightly affected, but in the graver forms constitutional symptoms, with anorexia, vomiting, and tympanites, are observed.

DIAGNOSIS.—The disorder is to be distinguished from a *syphilitic pemphigus* (more properly a bullous syphiloderm) which affects the palms of the hands and the soles of the feet, while in the non-syphilitic variety these regions escape. Thus the luetic variety can be differentiated by its distribution, by the other evidences of syphilis, and by a Wassermann reaction. Spirochetes have been found in the bullæ, which furthermore leave a rusty or ham-colored base behind them.

ETIOLOGY.—Maguire showed that in every fatal case the umbilical stump had been infected. Pus organisms are transferred by midwives or attendants to the newborn, thus spreading the infection.

TREATMENT.—The blebs should be **punctured** by a fine sterile needle and the contents absorbed with cotton. A dressing with **boric acid** or **zinc stearate** is then applied. If

systemic symptoms appear, **stimulation**, with **careful feeding**, is used.

In the furunculosis and pemphigus in children, the author has applied on a large scale **Lewandowsky's method** of dislodging the staphylococci from their nests in the horny layer of the skin where they start the abscesses. This is accomplished by **vigorous sweating**; the staphylococci thus drawn forth are then killed by immersing the child in a bath of 1:10,000 solution of **mercuric chloride**. The child is first given a hot bath and then the **pack**, with **warm drinks**, and, possibly, from 0.2 to 0.3 Gm. (3 to 5 grains) **aspirin**. The **furuncles** are **opened and sponged out** in the bath and the **body lightly rubbed**. The child is then rinsed off, wiped dry, and dusted with **talcum powder**. This procedure is repeated every day for two or three days, the loss of fluids being compensated by plenty of **warm drinks**. The children tolerate the sweating and baths well, and in a number of cases in which all other measures had proved ineffectual the furunculosis was cured by the end of one or two weeks, and the general health much improved under the cautious **diet**. This treatment has proved successful even with very frail infants suffering from general furunculosis. The same method has been applied with excellent results in the acute pemphigus of the newborn, supplemented by application of a mixture of 5 parts **ichthyol** and 5 parts **glycerin** in 100 parts water. A. Reiche (Therap. Monats., May, 1909; Jour. Amer. Med. Assoc., June 12, 1909).

SCLEREDEMA.

Much confusion has resulted from descriptions of this condition based upon the known symptomatology and pathogenesis of scleroderma of adults. Pediatricists distinguish two conditions having their own separate entity, viz., *scleredema* and *sclerema*.

SCLEREDEMA is oftener seen in this country than sclerema.

Symptoms.—After a few hours of depressed heart action and irregular, shallow breathing, edema appears on the dorsum of the feet, the face, and over the symphysis; next the entire lower extremities become edematous, the genitals are swollen, but the chest may remain free for a time at least. The skin is either mottled, cyanotic, or deadly white; on palpation, it pits and gives a putty-like feeling. The temperature is usually subnormal, and systemic disturbance is noted by marked apathy and anorexia. The urine, although scant, does not contain albumin. The weight may remain stationary or even increase, owing to the infiltration of the subcutaneous tissues and underlying muscles with a fluid exudate. Collapse supervenes unless treatment retards the progress of the condition. The temperature may drop to 95° F. (35° C.), and in a case observed by the writer the dairy thermometer used registered 84° F. (30° C.).

Etiology.—Scleredema affects premature or otherwise enfeebled infants during the first week of life, and is prevalent chiefly in the winter months. The lowering of the body temperature during this period, with its influence on the metabolism of the unorganized infant, is probably the exciting cause.

Prognosis.—The prognosis is grave in those infants in which the edema spreads rapidly and is extensive. Mild cases often react favorably to treatment.

Treatment.—Maintenance of the body heat to the normal should be the first consideration. This is

best accomplished by warm baths, the water of which is raised gradually until the child is in a hot bath of 105° F. (40.5° C.). The bath should be given for twenty minutes out of every two hours, if necessary, with gentle massage.

The recommendation of Badaloni to use inunction of glycerin with 10 per cent. of ammonium iodide is worthy of a trial. Breast feeding, or at least breast milk given by a Breck feeder, if the child is too weak to suckle, is quite essential.

SCLEREMA.—This is a very rare affection which occurs in the newborn, but is not restricted to this period.

Symptoms.—The lower extremities are the first to be involved (simultaneously). The calves, in particular, are noticeably affected. The condition then spreads upward over the thighs, trunk, and neck, the upper extremities being the last to show involvement. It has a selective action on the portions of the body richest in fat. The skin soon becomes inelastic, firm, and board-like; it does not pit on pressure. Constitutional symptoms are always present; the temperature is markedly subnormal; the urine becomes scanty, but no albumin is found; the tongue and mucous membranes become dry, the face immovable, and if the child lives long enough the involved areas become atrophic. Purpuric or ecchymotic areas appear in the skin. Nutrition being interfered with, weight is rapidly lost; the pulse and respiration become abnormally low, and coma or convulsions may precede the exitus.

Diagnosis.—Sclerema is distinguished from *scleredema* by the absence of swelling, the absence of pit-

ting of the skin on pressure, the indurated, hard, wax-like feeling in the tissues, and the profundity of the systemic involvement.

Etiology.—Sclerema has been observed up to the sixth month of life. It is most often secondary to the infectious diarrheas, and like them is seen largely in the summer months.

Pathology.—At autopsy no characteristic gross changes are found. The skin is hard and dry, and no fluid escapes. Atelectasis is commonly found. Knöpfelmacher, as a result of his investigations, concludes that the disease is rendered possible by the fact that the fat of newborn infants contains approximately 20 per cent. less oleic acid than in later life, while the palmitic and stearic acids, which congeal at a higher temperature, are present in greater amount in the nurslings.

Prognosis.—This is invariably grave in the newborn, particularly when the condition is secondary to a gastroenteric infection.

Treatment.—This consists in restoration of the body heat by **hot baths**, and the hypodermic injection of **normal saline solution**, 2 to 3 ounces (60 to 90 c.c.) every six hours, or, when practicable, the injection of **human blood-serum**, 5 fluidrams (20 c.c.), preferably from a parent. The latter serves not only the same purpose as the saline, but is further of advantage because of its nutritive value. **Caffeine** hypodermically, or a strong infusion of **coffee** per rectum, assists in maintaining a proper degree of stimulation.

SPONTANEOUS HEMORRHAGES IN NEWLY BORN.

Bleeding during the first days of life is the cause of many deaths or

permanent injuries. Its importance has attracted many workers, who have attempted in particular to solve the etiology, and to develop the therapy in these conditions.

The term *hemophilia neonatorum* must be discarded when applied to the whole group of *spontaneous* hemorrhages, since it has been quite conclusively proven that these have no true relation to hemophilia; on the contrary, the latter condition is very rarely manifested in the newborn. Spontaneous hemorrhages, or the so-called "hemorrhagic disease," must be sharply differentiated from the accidental, or traumatic, hemorrhages which are incident to the process of delivery.

SYMPTOMS.—The onset usually occurs before the tenth day, and often as early as the second day. The umbilicus is the most common seat; the intestines, mouth, stomach, conjunctiva, and ears (Ritter), in the order given, follow in frequency. Where infants are closely observed, premonitory symptoms will be noted; otherwise the first indication may be the bleeding. Before this takes place, the infant will be restless, refusing to suckle, and may have abdominal pain.

The external hemorrhage may be associated with varying degrees of internal hemorrhage. A preceding high temperature is unusual; vomiting or diarrhea is the rule. The type of hemorrhage varies considerably; it may be so massive as to cause death within a few hours or there may be only a slight intermittent oozing. General prostration and symptoms of collapse will vary with the extent and rapidity of the bleeding.

Bleeding from the intestinal tract,

commonly designated as *melena neonatorum*, will be evidenced by quite characteristic stools and vomiting of disintegrated blood.

In syphilitic cases the bleeding is rarely profuse, and is often nasal in origin. Other evidences of lues are generally to be found. The urine is occasionally blood stained, while the skin and subcutaneous tissues are subject to subcuticular hemorrhage at points of pressure, or from careless handling.

ETIOLOGY.—The trend of opinion points strongly toward bacterial infection, delayed or lost blood coagulation, and syphilis as the principal factors of spontaneous hemorrhage to be considered. The luetic condition is a predisposing one, and in some cases no other satisfactory cause can be found. Writers also have attributed these hemorrhages to abnormal conditions of the blood, or of the vessels themselves.

[Hemorrhagic conditions of the newborn may, according to Hamill (Archives of Pediatrics, vol. xx, No. 9), in certain instances be due to some of the causes formerly held accountable for all such manifestations. Among these may be mentioned birth trauma, fetal malformations, asphyxia, and syphilis. In the vast majority of instances, however, hemorrhages may be considered as symptoms of an infectious condition. Strong evidence in favor of the infectious nature of all such conditions as melena, Winckel's disease, etc., rests in the fact that they are observed almost exclusively in institutions and not uncommonly in epidemic form. Of micro-organisms, the streptococcus, the *Bacillus coli communis*, and the staphylococcus are the ones which have been most commonly encountered. These infections occur most frequently in maternity hospitals.

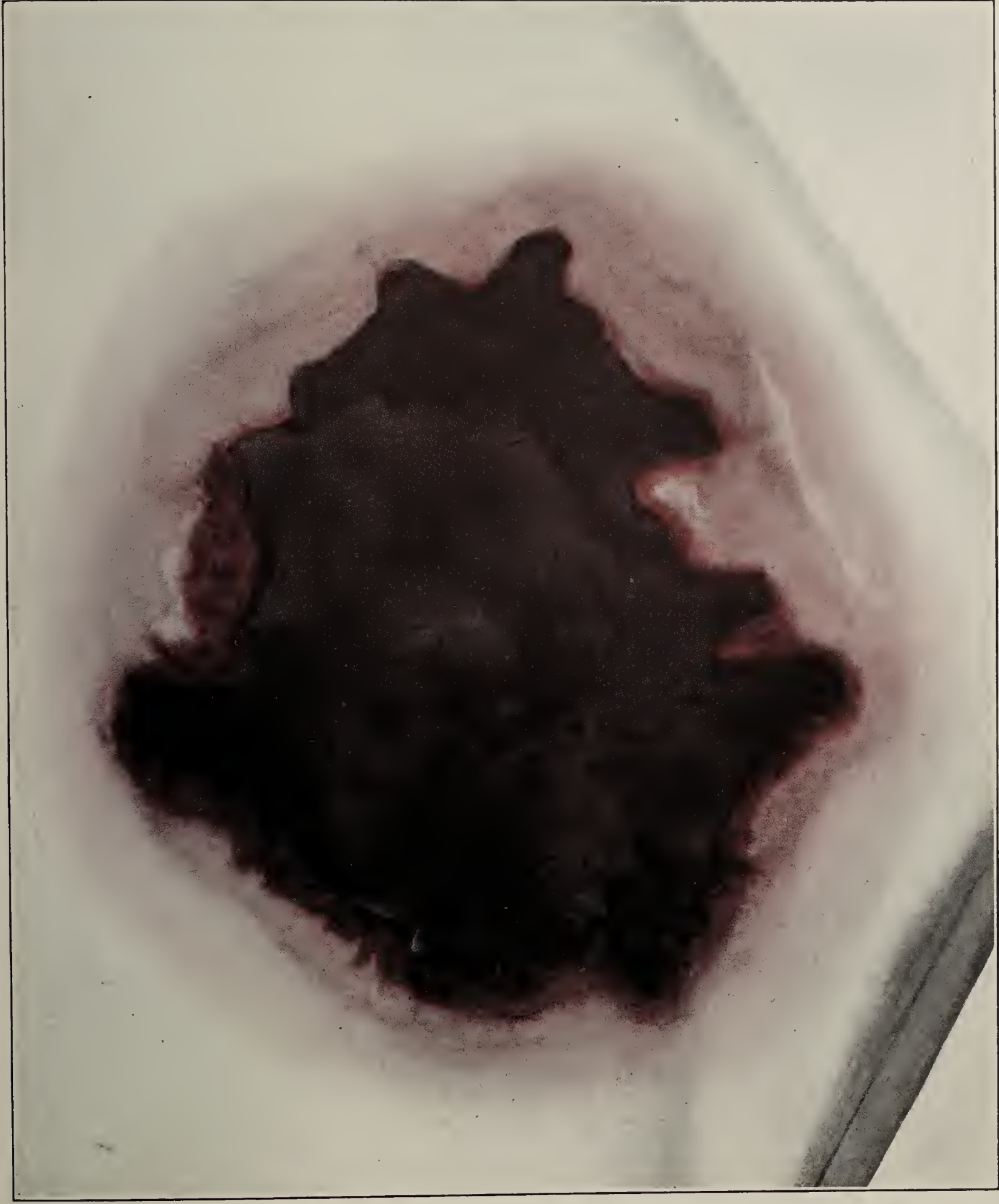
Schwarz and Ottenberg, in their article on "Hemorrhagic Disease of the Newborn," conclude as follows: Impaired

blood coagulation is the immediate cause of uncontrollable hemorrhages in the newborn. This is probably due to destruction of, or interference with, the production of thrombokinase. Bacterial infection is the most frequent underlying cause of the disease; but syphilis alone can cause the disease without bacterial infection. It is important that transfusion should be tried when ordinary measures have failed. G. R. PISEK.]

The following classification, arranged by Langmead, is serviceable for purposes of differentiation of the various types of hemorrhages:—

- A. Those mechanically produced at birth:—
 - 1. Cephalhematoma.
 - 2. Intracranial hemorrhage.
 - 3. Hematoma of the sternocleidomastoid muscle.
 - 4. Visceral hemorrhage.
- B. Vaginal hemorrhage.
- C. Umbilical hemorrhage.
- D. Hemorrhage due to infection:—
 - 1. Syphilis.
 - 2. Septic.
 - 3. Epidemic hemoglobinuria (Winckel's disease).
 - 4. Buhl's disease.
- E. The "hemorrhagic disease."
- F. Hemorrhage due to severe jaundice.
- G. Hemophilia.

The seasonal incidence and the occurrence of hospital cases in groups tend strongly to confirm the theory of the infectious etiology of the disease. The earlier the onset of the disease, the worse its prognosis; after one week the prognosis becomes relatively and, after ten days, absolutely good. Clinically, the disease occurs in three fairly distinct types, the umbilical, the seromucous, and the purpuric, which have an approximate respective mortality of 60 per cent., 50 per cent., and 22 per cent. The gross total mortality is about 50



Stool from a case of "Hemorrhagic Disease" of the Newborn. Intestinal Type.

per cent. Green and Swift (Boston Med. and Surg. Jour., March 30, 1911).

PATHOLOGY.—The necropsy findings show no gross changes except the localized hemorrhages, or anemia of the organs due to general loss of blood. The intestinal canal may contain blood in various stages of decomposition, and its mucous membrane may show areas of ecchymosis. Those in which ulcers of the stomach or intestines have been found were probably cases with inflammatory changes.

Study of 4 cases of fatal hepatic hemorrhage, non-traumatic, in newborn infants, accompanied by considerable bleeding into the peritoneal cavity. Under the influence of an intoxication or a chronic infection in the mother, vascular lesions and cellular degeneration in the liver develop in the infant, diminishing the formation of fibrinogen and causing a deficient power of coagulation in the child's blood. Bonnaire and Durante (L'Obstétrique, Oct. 10, 1911).

In 200 necropsies analyzed by the writer, cerebral hemorrhage occurred in from 43 to 50 per cent. Hemorrhagic disease is often associated with cerebral hemorrhage. Malformations occurred in 15 per cent., of which only 4 per cent were multiple. Of these, developmental defects of the heart were most common, but those of the digestive tract were surprisingly numerous. Birth injuries were rare (0.7 per cent), but when they occurred they were usually in the spinal column. Acute infections were rare; bronchopneumonia was the most frequent. Warwick (Amer. Jour. Dis. of Children, May, 1921).

PROGNOSIS.—The collected statistics from various writers establish the mortality as ranging from 35 to 87 per cent. These figures bear, however, on cases that did not receive the benefit of more recent

treatment. The generally bad outlook has now been converted into a favorable one. Indeed, Welch, in a recent article, states that "the result of my further experience to date has demonstrated that **subcutaneous injection of normal human blood-serum** will control 100 per cent. of this type of hemorrhage." The cases that will be lost in the future are those secondary to a profound infection, such as syphilis; or in which there are massive hemorrhages due to ulcers of the stomach or duodenum, or bleeding into the organs themselves, death ensuing by reason of the region involved rather than the hemorrhage.

TREATMENT.—The formerly advocated treatment with gelatin, epinephrin, etc., must give way to one of the methods about to be described, which are dependent upon **blood transfusion, injection of blood-serum, or injection of whole blood directly** into the circulation or under the skin.

Bleeding surfaces which can be reached may be treated by the usual **surgical means**; but the underlying factor must be controlled at once by that one of the methods given below which is found most practical under the circumstances.

Horse or rabbit serum, such as is used for the preparation of diphtheria antitoxin, may be used in an emergency, 10 c.c. (2½ drams) being injected. This, however, is not recommended if **whole blood** is available, since the whole blood can be used immediately, and its formed elements will besides serve a useful purpose in promoting blood coagulation. The **blood from a parent** is preferable to that of a foreign donor. Twenty c.c. (5 drams) should be drawn from the vein of the forearm and injected into

the deeper tissues of the back, this being repeated every four to eight hours until the hemorrhages have been controlled.

In 3 cases the results of injection of **diphtheria antitoxin**—as the most convenient form of serotherapy—were remarkably favorable. One infant had melena neonatorum, another Hénoc'h's abdominal purpura, and the third hemorrhage from the umbilicus with sepsis and pernicious jaundice. The condition in the latter case was particularly grave, and is generally regarded as hopeless. He supplemented the serotherapy with a 5 per cent. solution of **calcium acetate**, giving up to 3 or 6 Gm. (45 to 90 grains) of the acetate in twenty-four hours. Blühdorn (Berl. klin. Woch., Jan. 6, 1913).

In cases in which haste is not so imperative, **human blood-serum** can be readily prepared according to **Welch's method** (N. Y. State Jour. of Med., Nov., 1913):—

To a heavy glass filter flask of about 400 c.c. ($13\frac{1}{3}$ ounces) capacity fit a rubber stopper having two perforations. Through one perforation insert a fusiform glass tube, containing a piece of cotton. Through the second perforation insert a U-shaped glass tube to the outer end of which a needle, caliber No. 19, is attached by means of a piece of soft-rubber tubing. The outer limb of the U-tube, carrying the needle, should then be cotton-plugged into a small test-tube and the entire apparatus sterilized at 150° C. (302° F.), dry heat, for half an hour.

In preparation for withdrawing the blood a tourniquet is placed around the arm just above the biceps and pressure enough exerted to almost obliterate the radial pulse. After extreme engorgement of the veins

has been produced, the needle of the apparatus is inserted into a prominent vein at the cubital space and about 10 ounces (300 c.c.) of blood withdrawn into the flask. The rubber stopper is then withdrawn and a sterile cotton plug inserted into the flask, which is then placed in a slanting position, at room temperature (not on ice), until the coagulum has contracted and expressed the serum, which can then be decanted into a sterile flask and placed on ice for use as described. Enough serum will collect in one hour for an initial injection and the beginning of the treatment need not be delayed longer.

In giving the injections it is advisable to use a glass syringe, which can be thoroughly boiled, as the use of chemicals for the sterilization of the instrument might cause some alteration of the serum, either neutralizing or rendering it toxic.

One ounce (30 c.c.) of the serum is given at each injection—twice daily—to moderate bleeders; to those bleeding profusely it should be given three times daily or every four hours until the bleeding is under control, which is usually within twenty-four hours. It is best given subcutaneously, very slowly, and with gentle massage over the site of administration until all of the serum injected shall have been taken up by the circulation.

Case of umbilical hemorrhage in which the blood began to clot only when **serum from the father** was introduced into the veins of the infant. Richards (Med. Record, Jan. 13, 1912).

The **subcutaneous or intramuscular injections** have a distinct advantage over actual **transfusions** for two reasons: (1) That the latter requires special skill for its performance, it

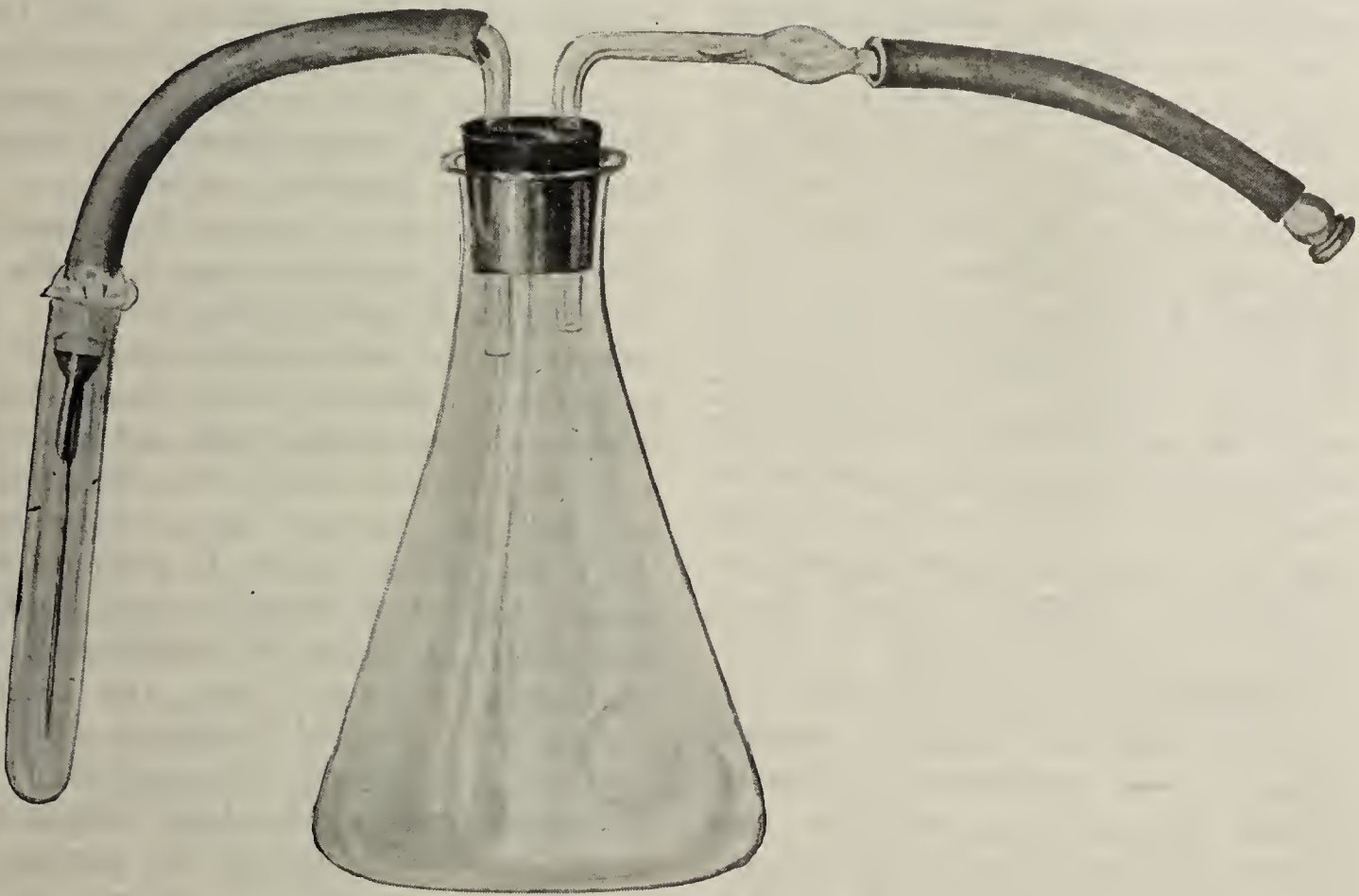
being a delicate operation even in the adult and requiring special appliances; and (2) the difficulty in obtaining suitable donors. The injection of **blood-serum** is a very practical measure. Nicholson (Therap. Gaz., Feb., 1912).

Case of a premature infant at eight months, taking nourishment badly, and steadily losing weight. Subcutaneous injections of **normal human serum**, from 20 to 78 c.c.

lene. Dexterity and speed are necessary for success.

In 9 newborn patients with hemorrhage, the writers treated 7 by subcutaneous injections of **human blood**. Schloss and Commiskey (Amer. Jour. of Dis. of Children, April, 1911).

A case of **blood transfusion** by the **citrate method** in a 60-hour old baby with melena, 60 c.c. (2 ounces) of blood being injected. Recovery was



Flask for collecting blood-serum (Welch's method).

($\frac{2}{3}$ to $2\frac{3}{5}$ ounces), a total of 896 c.c. ($1\frac{4}{5}$ pints) in twenty-one days were given with some benefit. The child improved and was able to nurse well. In 32 cases of newborn infants suffering from hemorrhage, this treatment was successful. Welch (Amer. Jour. of Obstet., April, 1912).

Lindeman's method differs in the respect that **whole blood** is used in special syringes and cannulas. If necessary a large measured quantity can be quickly transferred to the recipient, injection being made directly into a vein. The cannulas only are lined with a film coating of albu-

mineventful. To 10 c.c. ($2\frac{1}{2}$ drams) of sterile 2 per cent. sodium citrate solution were added 100 c.c. ($3\frac{1}{3}$ ounces) of blood from a vein in the father's arm. Woltmann (Jour. Amer. Med. Assoc., Dec. 18, 1915).

Vincent advocates **blood-transfusion** by a method which he has made comparatively simple. In skilled hands, in a properly equipped hospital, the method may be adopted, but we have had no experience with this method, while the simplicity of the measures outlined above outweighs any advantages which it may have.

Fourteen cases of hemorrhage in the newborn treated by **direct transfusion of blood**. The arm of the donor is placed beneath the left thigh of the infant, the palmar aspect of the hand uppermost, so that the radial artery of the donor and the femoral vein of the baby may be joined. During transfusion the child's color greatly improves, it becomes vigorous, gains from 8 to 14 ounces (240 to 420 Gm.) in weight and is usually strong enough to nurse. By weighing the baby before and after transfusion, the amount of blood received must vary from 8 to 15 ounces (240 to 450 Gm.). These patients are not hemophiliacs and they usually recover rapidly after transfusion, and do well. The smallest baby treated weighed 4 pounds (1920 Gm.). The period of transfusion varies from five to fifteen minutes. The vessels used were the radial artery in 7 cases, and the forearm vein in 7 cases on the donor; on the baby, the femoral vein was used in 4 cases, and the jugular in 10 cases. Lespinasse (*Jour. Amer. Med. Assoc.*, June 13, 1914).

Transfusion is a procedure of definitely established specific curative value in the treatment of hemorrhagic disease of the newborn. By its use the mortality of this disease has already been reduced from 50 to 10 per cent. A probable further reduction of mortality may be expected in the future from its prompter and universal application. Successive improvements and simplifications in the technique of transfusion have now made its performance possible by surgeons of average training, experience, and skill. Of all the methods thus far devised, that of Kimpton seems distinctly superior in certainty, speed, and ease of accomplishment. Even with transfusion, the prognosis in the rare cases of hematuria is apparently much worse than in any other form of bleeding. The greatest present need of further investigation in hemorrhage of the newborn is into the knowledge of its probably syphilitic etiology. R. M.

Green (*Boston Med. and Surg. Jour.*, Nov. 5, 1914).

[**Vincent's method** used in 11 cases, treated by blood transfusion, is described thus (*Archives of Pediatrics*, Dec., 1912): The glass tubes are 13 cm. long and 3 mm. in diameter. At either end the tubes are encircled by a shallow groove that carries the ligature by which the vessel is secured. They are coated with paraffin to prevent clotting of the blood. The radial artery of the donor and the external jugular vein are used. A flow of five minutes is usually sufficient, care being taken that the blood is not transferred too rapidly or in too large a quantity. Transfusion is stopped when the infant's face becomes a normal red color.

In all of Vincent's cases the immediate effect of the procedure was to check the bleeding and correct the anemia. The infants in the successful cases were apparently changed at once from sick to healthy children, who slept and nursed in a normal manner, with the exception of one with an excessive hemorrhage under the scalp. Eight of the 11 patients were cured. One died within twenty hours of peritonitis, as shown by autopsy; 1 died of syphilis a month later, the bleeding having been stopped by transfusion, and the third, although exsanguinated and moribund from a two days' hemorrhage of the cord, was revived by transfusion, but died in twenty-four hours. G. R. PISEK.]

Details of 67 cases recorded during the last twenty-three years. The mortality was 32.8 per cent., but it was only 10 per cent. in the 20 cases in which blood was found in the stools alone; 83.3 per cent. in the 6 cases in which it was found in the vomitus alone. Only 8.8 per cent. succumbed in the 34 cases in which **gelatin** was systematically given, mostly by the mouth and subcutaneous injection. A 1 or 2 per cent. solution was generally used, twice a 5 per cent. and once a 10 per cent., injecting 10 c.c. (160 minims) at a time, the injection of the weaker solutions repeated three or four times a day. As the 10 per cent. solution seemed to be tolerated with-

out harm, he thinks that a small amount of this would be better than larger amounts of a weaker solution. Vassmer (*Archiv f. Gynäk.*, Bd. lxxxix, Nu. 2, 1909).

Subcutaneous injection of **gelatin** in case of true melena should be supplemented by **breast milk given cold** by the teaspoonful, and **stimulants for the heart** and, in case of collapse, **saline infusion** with measures for **warmth**. P. Sittler (*Fort-schritte der Med.*, Feb. 24, 1910).

The treatment should be directed toward local hemostasis and increase of coagulability of the blood. **Gelatin** and **rabbit serum** are agents of proved value. **Quiet** and **isolation** are indicated in every case. **Blood transfusion** is a promising procedure which deserves further trial. The ideal treatment has not yet been demonstrated. Green and Swift (*Boston Med. and Surg. Jour.*, March 30, 1911).

The writer recommends **lumbar puncture** at once on suspicion of meningeal hemorrhage in a newborn babe. If this fails to relieve, the anterior fontanel should be punctured if it is bulging. After this it would be better to wait for the brain to develop more resisting power before attempting an actual operation to relieve pressure on the brain. Gilles of Toulouse prefers to puncture the fontanel at once, before doing even lumbar puncture, introducing the Pravaz needle, as far from the longitudinal sinus as possible, to a depth of 5 mm. or even 8. This draws the blood at once before it has had time to clot or be absorbed. **Puncture of the fontanel** is naturally merely an exploratory intervention, but it may have actual curative value as in a case reported by Gilles. Doazan (*Arch. gén. de chir.*, Jan., 1913).

EPIDEMIC HEMOGLOBINURIA (Winckel's Disease).

Winckel's disease is a rare and very fatal condition characterized by

icterus and the appearance of hemoglobin in the urine.

SYMPTOMS.—These usually appear about the fourth day, and are very severe from the onset. The skin is somewhat cyanosed, and jaundice appears.

There is but rarely any elevation of temperature; the pulse and respirations are exceedingly rapid; there are marked restlessness, depression, and a tendency to coma and convulsions.

The urine is expelled with some straining, and rather frequently, but in small amounts. It is smoky in character, and on further examination is found to contain hemoglobin, renal elements, granular casts, and blood-corpuscles. No bile is present, and albumin, excepting in traces, is rarely found.

ETIOLOGY.—Since Winckel described this condition in 1879, conceptions of many of the affections of the newly born have changed. There is little doubt that this condition is the result of an infection, and this is borne out by the fact that it occurs in epidemics, usually in institutions.

PATHOLOGY.—The skin is bronzed, due to the intense icterus. The spleen is enlarged and its pulp intermixed with blood-pigment. Fine punctate hemorrhages are often found in many of the larger organs, especially in the kidneys. The bladder contains the characteristic smoky urine.

PROGNOSIS.—This is almost invariably fatal, and the babe seldom lives longer than forty-eight hours.

TREATMENT.—The bacteremia is so profound that measures thus far proposed have not succeeded in saving life.

FATTY DEGENERATION OF THE NEWBORN (Buhl's Disease).

This is an exceedingly rare disease, bacteremic in nature, and characterized by fatty degeneration of vital organs, as the liver, heart, and kidneys. The changes in these viscera are not unlike those found in acute yellow atrophy. The disease begins about the fifth or sixth day, probably through an infection of the umbilical stump. Asthenia increases from day to day; the infant becomes exceedingly pale, then jaundiced, and hemorrhages appear in the skin and sometimes in the mucous membranes. Edema, which becomes general, ensues before the end. Death is seldom delayed beyond two weeks. No treatment has proven of avail.

SEPSIS OF THE NEWBORN.

That the tender infant is very susceptible to infection is recognized, but the effect of infection on infants is so varied that much confusion has resulted from descriptions which do not definitely give the proper place to micro-organisms as the etiological factor. The streptococcus, the *Bacillus coli communis*, and the staphylococcus are the organisms which are most frequently found by cultural methods in the blood-stream.

SYMPTOMS.—The onset is often during the first week of life. Fever is an early manifestation, and usually with an exceedingly high range. The respirations are irregular or labored in type, and diarrhea, with frequent green stools, is almost the rule. Depending upon the type of infection, systemic disturbances may ensue which direct the attention to one of the clinical forms of sepsis, *i.e.*, the symptoms may be mainly

meningeal, pulmonic, or referable to the gastroenteric tract.

Icterus is quite commonly seen, and with it may appear a maculopapular eruption, which later assumes pustular characteristics. The infant refuses to nurse and loses weight rapidly, and hemorrhages are apt to occur in any part of the body. Twitching, carpopedal spasms, or other evidences of cerebral irritation ensue. Convulsions occur if the toxic condition does not abate.

ETIOLOGY.—Wherever infants are grouped together in numbers, as in maternity hospitals or foundling asylums, septic cases are apt to occur. This is due to contact infection, infected dressings, or diapers, or to the carrying of organisms by the hands of untrained attendants from patient to patient. During parturition the infant may be infected through the vaginal discharges, or the umbilical stump may receive the micro-organisms from unclean hands or instruments.

[As Hamill and Nicholson point out (Archives of Pediatrics, vol. xx, No. 9), pathogenic micro-organisms are apt to be introduced in the presence of suppurative lesions of the breast. Even in milk from apparently normal breasts micro-organisms—mainly the *Staphylococcus aureus* and *albus* and the streptococcus—have been isolated. The nature of these micro-organisms, and the fact that in the udder of the cow concealed foci of suppuration are not uncommon, would suggest the likelihood of a similar condition in the human breast.

It is impossible, definitely, to fix upon the port of entry. The buccal cavity, the tonsils, pharynx, and the remainder of the alimentary tract are the most common. Next in order may be implicated the lungs. The umbilical cord has been given too great prominence as the point of entrance, and the other avenues named—skin, conjunctiva, nose, ears, and urogeni-

tal tract—are rarely responsible. G. R. PISEK.]

PATHOLOGY.—Since the septic process may invade almost any organ or structure of the body, the lesions are necessarily varied. The organs almost invariably show marked congestion, cloudy swelling, and infiltration or fatty degeneration. Hemorrhages into the organs are exceedingly common. Lymph-nodes draining the infected tracts are found enlarged. The mucous membrane of the intestinal tract is engorged and thickened; it is not uncommon to find Peyer's patches or the follicles unduly prominent, or various stages of ulceration may occur.

PROGNOSIS.—This should be guardedly given, even in seemingly mild forms. In private practice the outlook is decidedly better than it is in institutions.

TREATMENT.—PROPHYLACTIC.—Pediatrists today recognize that sepsis must be fought with **surgical cleanliness** if infants are to be cared for in numbers. Scrupulous attention must be paid to **prevent contact infection**. In institutions, if the infants had an abundance of **sunlight** and **fresh air**, if they could be daily removed to freshly aired pavilions, and could be placed in separate cubicles to sleep, then, with cleanly attendants, the occurrence of sepsis would be markedly reduced.

GENERAL.—The treatment of the infection itself is mainly symptomatic unless it is possible to prepare a **vaccine**, which should be tried. Localized **abscesses** must be **opened and drained**. **Forced feeding**, injection of **saline solution**, and cardiac stimulation with **whisky** are indicated. We have had a measure of success by in-

jections of **homologous blood-serum** in some cases which seemed hopeless.

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New York.

NICKEL (Nicolum).—Metallic nickel is not used in medicine, but several of the salts (bromide, carbonate, hydrochloride, and sulphate) have been experimented with; none of the preparations of nickel is official.

Nicoli Bromidum (nickel bromide) occurs as green, deliquescent needles or prisms which are soluble in alcohol, ether, and water. Its physiological action is analogous to that of sodium bromide. It must however be given largely diluted, as it is more irritant to the stomach. The dose is 10 grains (0.60 Gm.), which corresponds to 30 grains (2 Gm.) of the sodium salt.

Nicoli Sulphas (nickel sulphate) occurs as a green, crystalline powder or as emerald-green, transparent, rhombic prisms, which effloresce on exposure. It is soluble in 3 parts of water and is insoluble in alcohol and ether, has a sweetish, styptic taste, and has tonic, sedative, and soporific properties. The dose is $\frac{1}{2}$ to 1 grain (0.03 to 0.06 Gm.) three times daily.

Kolipinski has found the sulphate an excellent antiseptic and bactericide, of especial value in the **parasitic skin diseases**, applied in a 1 or 2 per cent. aqueous solution. Given in doses of 1 grain (0.06 Gm.), after meals, he derived benefit from its use in **chorea**, **motor disturbance** with **spasm** and **inco-ordination**, much like **chorea**, **chronic neuralgia** of the face, **tic douloureux**, **migraine**, **chronic enteritis**, **epilepsy**, **emotional and psychic weakness**, and **neurasthenia**. W.

NINHYDRIN.—Ninhydrin, or tri-keto-hydrinine-hydrate, occurs in the form of colorless crystals which are readily soluble in water. The aqueous solution stains the skin violet and reduces Fehling's solution. An aqueous solution heated to the boiling point remains colorless, but will turn blue if there are in it protein bodies or amino (amido) acids derived from them which have the amino

group in the alpha position in reference to the carboxyl. The reaction is more sensitive than in the biuret test. Ninhydrin is not employed therapeutically, but is used as a reagent for detecting the presence of albumin, peptone, polypeptides, and amino-acids, and is especially valuable in demonstrating in the blood-serum the presence of specific proteolytic ferments according to the method of Abderhalden as a means of diagnosis in pregnancy, carcinoma, tuberculosis, etc. (For its use in the diagnosis of pregnancy see Abderhalden Test, vol. v, 389). The technique of the test for proteolytic and peptolytic ferments is similar to that of the pregnancy test. In testing for carcinoma, however, carcinomatous tissue must be used instead of placental tissue, and in testing for tuberculosis albumin obtained from tubercle bacilli must be used. The blood-serum used, in all cases, must be fresh and absolutely free from hemoglobin.

After a series of unfavorable results with Abderhalden's reaction of the blood, it occurred to Warfield that if there was a specific ferment in the blood-serum elaborated to split up the products driven from the placenta, especially syncytium, there should be also in the blood-waste such products of the metabolic activity of the growing fetus. These would have to leave the body by some route, and the most logical one was the urine. They should be peptones and amino-acids and should dialyze out and possibly be found by means of the ninhydrin reaction in the dialysate. "It was found that actually such is the case. At first urine and pieces of boiled placenta were placed in one dialyzer, and urine alone in a second dialyzer. No difference was noted in the color or reaction obtained with ninhydrin. Boiling the urine made no difference. Urine containing more than a trace of albumin boiled and filtered to clear of albumin and placed in the dialyzer showed, in the reaction of the dialysate to ninhydrin, no difference from the untreated specimen of urine." Seventeen cases were tested, four of them twice, and every case of pregnancy reacted except one of only two months' duration. Control tests of healthy persons were made, all negative. At four

and one-half months of pregnancy the ninhydrin test of the urine gives an intense blue color. W.

NIPPLES, DISEASES OF. See MAMMARY GLAND AND LACTATION, DISORDERS OF.

NITRIC ACID.—*Acidum nitricum*, U. S. P. (hydrogen nitrate, or aqua fortis), is a transparent, colorless (or of slightly yellow tinge), fuming (white or grayish fumes), suffocating, and caustic liquid, strongly acid and volatile with heat. It should have a specific gravity of 1.403 (42° Baumé) and contains 68 per cent. of absolute acid. It is miscible in all proportions with water, and when added to alcohol decomposes it with violence. It should be kept in a dark-amber, glass-stoppered bottle, as it is decomposed by the action of light and air. It is the strongest of the mineral acids, and is usually exhibited in the dilute form.

PREPARATIONS AND DOSES.—The official preparations of nitric acid are the following:

Acidum nitricum (68 per cent. absolute nitric acid), used only in preparations.

Acidum nitricum dilutum (nitric acid, 10 per cent.). Dose, 5 to 30 minims.

Acidum nitrohydrochloricum (nitric acid, 18 per cent.; hydrochloric acid, 82 per cent.). Dose 2 to 5 minims.

Acidum nitrohydrochloricum dilutum (nitric acid, 4 per cent.; hydrochloric acid, 18.2 per cent. Dose, 10 to 20 minims.

Mistura camphoræ acida, N. F. (Hope's mixture). Dose, 2 drams (8 c.c.). This mixture, though not official, is a favorite astringent sedative used in dysentery. It is composed of nitric acid, 30 minims (1.75 c.c.); tincture of opium, 20 minims (1.2 c.c.); camphor-water, to make 25 drams (100 c.c.).

PHYSIOLOGICAL ACTION.—In weak solution nitric acid slightly stimulates the tissues, but applied pure it destroys them, and is, on this account, classified as a very powerful caustic. Internally it may, of course, only be used greatly diluted, and its powers as a stimulant manifest themselves mainly upon the glandular elements of the gas-

trointestinal tract. When taken internally for some time, nitric acid colors the gums as does mercury.

A very small proportion, if any, of the acid is eliminated through the kidneys; it is eliminated almost entirely through the intestines.

It is probable that nitric acid enters the blood, where it is converted into a nitrate. Some of the organic nitrates have been shown by Bradbury to stimulate the vasomotor system, the glycol-dinitrate, for instance, acting somewhat like nitroglycerin. This effect varies with the individuals, some showing comparative insusceptibility. Other nitrates act transiently as vasodilators.

POISONING BY NITRIC ACID.—

The symptoms of poisoning by nitric acid in concentrated form are those of an acute and violent inflammation of the digestive tract induced by the ingestion of a caustic irritant. They vary in severity and rapidity of development according to the strength and amount of the acid swallowed. The fact that when nitric acid comes in contact with organic matter it imparts to it a yellow color or stain, not easily removed, aids us in differentiating the traces of nitric acid from those of sulphuric (black eschar) or hydrochloric (white eschar) acid. Thus, we may look for yellow stains on the skin, in the mouth, and perhaps on the clothing. Great pain will be present throughout the entire digestive tract, associated with vomiting of a dark matter, resembling coffee-grounds (altered blood), and occasionally portions of mucous membrane; a feeble pulse, clammy skin, and profuse bloody salivation. Renal irritation may be severe and the urine and feces may contain blood more or less altered. Death may occur either from the gastrointestinal inflammation or from collapse. If recovery take place the patient may suffer from stricture of esophagus, stomach, or bowels, or from more or less destruction of the peptic tubules.

Treatment of Nitric Acid Poisoning.—

There are four indications to be met: (1) to neutralize the acid through the use of alkaline solutions,—**chalk, magnesia, sodium or potassium carbonates, scrapings from whitewash or plastered**

walls, or even soapsuds; (2) to protect mechanically the corroded and inflamed tissues, through the use of **white of egg, oils, and mucilaginous drinks (flaxseed-tea, barley-water, etc.);** (3) to relieve the pain, through the use of **opium;** (4) to counteract the depression of the vital powers, through the application of **external heat, the use of stimulating and nutrient enemata, and venous injections of ammonia.** If pure acid in any considerable amount has been ingested, favorable results must not be looked for. The smallest quantity of nitric acid that has produced death was 2 drachms. Death ensued in two hours.

Fatal accidents occasionally result from **inhaling the fumes** of nitric acid, which set up a bronchopneumonia, which demands **stimulation, the use of oxygen** when indicated by the cyanosis and symptoms of collapse, **atropine** for the edematous exudation, vigorous **counterirritation, leeches, with elimination and supportive measures.** After recovery work should be **forbiddn, all exposure avoided, and residence** should be in a warm, equable climate. The **infection of tuberculosis** should be **guarded against.**

THERAPEUTICS.—When nitric acid is taken internally it should be freely diluted and be taken through a glass tube to prevent its corrosive action on the teeth. When taken continuously for too long a period it may affect the gums like mercury (salivation and spongy gums, probably due to local action), and this should be an indication for suspending its use.

Internal Uses.—Nitric acid has been found to benefit patients suffering from **oxaluria, and from dyspepsia** with phosphatic urine. Its use has also been advised in **lithemia.** In **stomatitis** with the presence of small ulcers in the mouth and over the tongue the internal administration of nitric acid in small doses is followed by good results, especially if each ulcer be touched with a 60-grain solution of nitrate of silver. **Summer and colliquative diarrhea** are favorably influenced by the internal administration of nitric acid. Hope's camphor mixture (*Mistura Camphoræ Acida, N. F.*) yields good results in dysentery. In **chronic diseases of**

the liver nitric acid is useful, but nitrohydrochloric acid is better, especially in mucous duodenitis and catarrh of the gall-ducts and malarial jaundice. Intestinal indigestion associated with diarrhea yields kindly to nitric acid; when diarrhea is absent hydrochloric acid is to be preferred.

Chronic bronchitis and **hoarseness** produced by singing are said to be relieved by 10-minim (0.65 c.c.) doses of dilute nitric acid (Bartholow). In **whooping-cough** nitric acid is beneficial after the subsidence of the catarrhal stage, though some claim that it shortens the duration of the disease. Hammond, Bailey, and others have used nitric acid with success in the treatment of **intermittent fever**, giving it in full doses every four or six hours. It is also of great service in relieving **hepatic congestion**, after the paroxysm has been arrested by quinine. It is best given combined with the bitters.

Local Uses.—Nitric acid used locally is caustic, astringent, or stimulant according as it is used pure or diluted. Pure nitric acid is one of the most efficient and most controllable escharotics at our command. The area of action may be limited by the previous application of a ring of oil or of ointment, and the depth of action by the subsequent application of an alkaline solution or of soapy water. It may be applied as a caustic to **phagedenic ulcers**, **chancroids**, **cancrum oris**, and also **hospital gangrene**. **Warts** and **condylomatous growths** yield to its action. On **inoperative cancerous growth** it may be used as a palliative. **Free-bleeding hemorrhoids** may be relieved by touching the tumors lightly with the pure acid, through a speculum, and mopping the parts with oil liberally after the acid application.

The application of fuming nitric acid is the most effectual means of destroying the "virus" of **rabies** in wounds, if possible before it has germinated in the wound. This does not do away with the necessity of the Pasteur treatment, but only paves the way for it. Incidentally, we remark, that wounds made by rabid animals should not be sutured; they should be allowed to bleed.

Its application may be rendered painless by allowing as much cocaine as the quan-

tity of acid used will take up, to dissolve in it.

In gynecology pure nitric acid may be applied to the cervix or endometrium for the cure of **cervical endometritis**, **granular endometrium** or of small **fibroid tumors**. It is also used to arrest the **hemorrhage** from the mucous **membrane** which occurs after the operative removal of polypi or small tumors.

In rhinology nitric acid may be used, applied in a fine wire probe lightly wrapped with cotton, to remove **hypertrophy** of the erectile tissues covering the middle turbinated bones. A previous application of a 4 per cent. solution of cocaine renders the application painless. The acid should be applied lightly and only over the space covered by the probe. It may be repeated, if required, after the slough has separated and the parts healed.

The astringent action of nitric acid (1:500 parts) is appreciated when it is used to irrigate the bladder in cases of **chronic cystitis**, and as well when there are **phosphatic deposits** in the **bladder**. The solution should be slightly warmed before using.

Nitric acid as a stimulant (2 per cent. solution) is useful when applied to **unhealthy ulcerations** and to **irritated and bleeding hemorrhoids**.

Incidentally we may note the use of nitric acid as a test for detecting the presence of albumin in the urine; the methods for applying it for this purpose are given in full under **ALBUMINURIA** in volume i. S.

NITRITES.—The salts of nitrous acid [HNO_2] are termed nitrites. Those used in medicine, either as such or in solution as an officially recognized preparation, are sodium nitrite, ethyl nitrite (in sweet spirit of niter), and amyl nitrite. The last two of these, containing organic radicles, are properly termed esters of nitrous acid. With the nitrites may also be appropriately considered certain compounds which, though introduced in the body as nitrates, are

decomposed into nitrites before exerting their effects, viz., nitroglycerin (official in spirit of glyceryl trinitrate), and the two unofficial drugs, erythrol tetranitrate and manitol hexanitrate. Potassium nitrate, which liberates nitrites upon combustion, may likewise be included.

PREPARATIONS AND DOSE.

—The official preparations of the nitrite group are as follows:—

Amylis nitris, U. S. P. (amyl nitrite; isoamyl nitrite) [$C_5H_{11}NO_2$], occurring as a yellowish, transparent, very diffusive, unstable liquid of specific gravity approximating 0.870, with a penetrating ethereal, fruity odor, and a burning, aromatic taste. The official preparation is required to yield not less than 80 per cent. of pure amyl nitrite when assayed by a specially prescribed process. It is almost insoluble in water, but is miscible with alcohol, ether, and chloroform. It boils at approximately $208.4^{\circ} F.$ ($98^{\circ} C.$), and is inflammable. It decomposes gradually on exposure to light or air. Dose, by inhalation, 1 to 5 minims (0.06 to 0.3 c.c.); internally, doses of 3 to 8 minims (0.2 to 0.5 c.c.) have been used.

Sodii nitris, U. S. P. (sodium nitrite) [$NaNO_2$], occurring in colorless crystals or in white fused masses (sticks), odorless, and with a mild, saline taste. The salt is officially required to be not less than 90 per cent. pure. It is soluble in about 1.4 parts of water, and slightly soluble in alcohol. Upon exposure to the air it deliquesces and gradually becomes oxidized to sodium nitrate. It is non-volatile and non-explosive. Dose, 1 to 3 grains (0.06 to 0.2 Gm.).

Spiritus ætheris nitrosi, U. S. P. (spirit of nitrous ether; sweet spirit

of niter), made essentially by the gradual addition of a solution of sodium nitrite to previously diluted sulphuric acid, washing the ethyl nitrite [$C_2H_5NO_2$] separated from the mixture, and mixing it with twenty-two times its weight of alcohol. The product, when specially assayed, is required to contain 4 per cent. of pure ethyl nitrite, and is a clear, volatile, inflammable, slightly greenish or yellowish fluid, with a fragrant odor and burning taste. Upon prolonged keeping, or free exposure to air and light, it becomes acid in reaction. Dose, 15 minims (1 c.c.) to 4 fluidrams (15 c.c.); official average dose, 30 minims (2 c.c.).

Spiritus glycerylis nitratis, U. S. P. (spirit of nitroglycerin; spirit of glonoin; spirit of glyceryl trinitrate), an alcoholic solution containing 1 per cent. by weight of glyceryl trinitrate. It occurs as a clear, colorless fluid, with the odor and taste of alcohol. It is dangerously explosive if the alcohol be partly or wholly lost by evaporation. Dose, 1 to 2 minims (0.06 to 0.12 c.c.).

Potassii nitras, U. S. P. (potassium nitrate; niter; saltpeter) [KNO_3], occurring in colorless crystals or powder, with a saline, pungent taste, soluble in 3.6 parts of water, but very sparingly in alcohol. It is used in solution to saturate filter-paper, stramonium or tobacco leaves to be employed in bronchial asthma. The nitrites produced through combustion of these preparations are inhaled and relax the contracted bronchioles.

Pilulæ glycerylis nitratis, N. F. (pills of nitroglycerin or glonoin), each containing 1 minim (0.065 c.c.) of spirit of nitroglycerin, with althea and confection of rose. Average dose, 1 pill.

Unofficial compounds are:

Nitroglycerin (glyceryl trinitrate, trinitrin, glonoin) $[C_3H_5(NO_3)_3]$, a volatile, explosive fluid, contained in the spirit of glyceryl trinitrate, and also commonly in the form of hypodermic tablets or tablet triturates. Its volatility renders these latter preparations unreliable. Strong alkalis remove its explosive power by decomposing it. Dose, $\frac{1}{100}$ minim (0.0006 c.c.).

Erythrol tetranitrate (tetranitrol) $[C_4H_6(NO_3)_4]$, a slightly volatile solid, highly explosive, practically insoluble in water, and marketed usually in tablets, which should preferably be coated to delay deterioration. Dose, $\frac{1}{2}$ to 1 grain (0.03 to 0.06 Gm.). (See also ERYTHROL TETRANITRATE.)

Mannitol hexanitrate.

Amyl nitrite, in glass pearls, keeps well if not exposed to the light. A change in color makes practically no difference in activity. Tablets of nitroglycerin containing $\frac{1}{100}$ grain (0.0006 Gm.) each, may retain their activity for a year or more; yet comparatively fresh tablets are often inert. It is advisable to use solutions instead. A 1 per cent. solution keeps fairly well. If diluted, however, it may weaken markedly.

Solutions of sodium nitrite deteriorate rapidly; a solution should not be used which is over a week old.

Chocolate-coated tablets of erythrol tetranitrate, even after being kept for one year, retain their full activity. G. B. Wallace and A. I. Ringer (Jour. Amer. Med. Assoc., Nov. 13, 1909).

PHYSIOLOGICAL ACTION.—

Circulatory system.—The chief action of the nitrites is upon the circulation, and in this field, in turn, their direct influence is exerted upon the blood-vessels rather than the heart itself. The muscular tissue in the vessel

walls is powerfully depressed by the nitrites, with the result that these walls yield to the pressure of blood within, which pressure, since the total amount of fluid in the cardiovascular apparatus undergoes no simultaneous increase, recedes in consequence. That the effect is not exerted through an action on the vasomotor centers is indicated by the fact that the pulmonary arteries, which are not considered to possess vasomotor nerves, are dilated by the nitrites like other arteries, and conclusively shown by the fact that if, in an experiment, a nitrite be injected so that it will reach the medullary centers but cannot enter the general circulation, the characteristic fall of blood-pressure will not take place. If a nitrite be added to fluid passing through the vessels of an isolated organ or limb, the outflow from these vessels is markedly increased, showing the direct vasodilator effect of the drug. The vessels of the splanchnic area are the most strongly affected by nitrites, but a powerful action is also exerted in the arteries of the brain, lungs, heart, and limbs, and superficially in the neck and head, the skin of which becomes flushed. The veins have been shown to be influenced like the arteries.

The action of nitroglycerin was manifested in 16 out of 23 cases by subsidence of pressure in the brachial artery, while at the same time the pressure rose in the arteries in the fingers. The drug has an elective action on the peripheral portion of the circulation. As it dilates the arterioles, the work of the heart is lightened. If the heart is very weak and close to exhaustion the blood-pressure in the finger arteries rises very little if at all. The power of

dilatation of the peripheral vessels determines the amount of action of the nitroglycerin. When the peripheral vessels have lost their elasticity under the influence of typhoid, tuberculous, or diphtheria toxins, nitroglycerin is useless. It is indicated in cases in which pressure at the periphery rises while the brachial pressure drops under its influence. This phenomenon is particularly evident when patients feel worse after administration of digitalis. Dmitrenko (Zeit. f. klin. Med., Bd. lxxviii, Nu. 5-6, 1909).

All the nitrites produce prompt relaxation of rings from the coronaries of the ox and pig, placed in warm oxygenated Locke's solution. This dilator action of the nitrites tends to explain their favorable action in angina pectoris. C. Voegtlin and D. I. Macht (Jour. of Pharm. and Exper. Therap., Sept., 1913).

Nitrites found experimentally to produce a constriction of the pulmonary artery. This action points to a rational method of treating hemoptysis. Macht (Jour. of Pharm. and Exper. Therap., Sept., 1914).

During the drop in blood-pressure produced by a nitrite the heart rate increases—by as much as 20 or 30 beats per minute after amyl nitrite. This has been shown not to be due to a stimulating effect on the heart, and is considered the result either of a reflex depression of the vagus (such a reflex action normally follows a fall in blood-pressure, however caused), or to a direct depression of the vagus centers by the drug. In old persons, whose hearts are comparatively free from vagus control, the pulse rate does not become accelerated after amyl nitrite inhalation as it does in the young (Hewlett). Sollmann showed that if the nitrite is confined to the cerebral circulation, an increase in the heart rate occurs

in spite of the fact that the general arterial pressure is not lowered, while if the drug is confined to the general and excluded from the cerebral circulation, a fall in pressure takes place without any consequent acceleration of the heart. The view formerly held that nitrites, in particular nitroglycerin, stimulate the heart-muscle, has been proven, at least in large degree, erroneous, by experimental work. In large amounts the nitrites directly depress the heart muscle.

In *rapidity and duration of action* the different nitrites vary to a marked extent. Amyl nitrite, inhaled, causes the blood-pressure to drop within a few seconds by from 20 to as much as 70 millimeters of mercury; the pressure then rises almost to the previous level in two to five minutes, and has wholly returned to it in fifteen to twenty minutes. Nitroglycerin is promptly absorbed, whether given hypodermically or by mouth, but the greatest depression of blood-pressure is produced only in five to fifteen minutes. The effect usually passes off in from one-half to one hour, though in general arteriosclerosis Bastedo has seen it last several hours. Sodium nitrite comes next in the list, pronounced effects from it (when unweakened by exposure to air) beginning in ten to thirty minutes after the drug has been taken by mouth, and persisting for one to two hours. In the case of erythrol tetranitrate and mannitol hexanitrate the action begins somewhat later than with sodium nitrate, but continues for two to five hours. Ethyl nitrite is a very rapidly acting drug, like amyl nitrate, but as it is customarily taken by mouth, the char-

AVERAGE BLOOD-PRESSURE RESULTS IN NORMAL PERSONS.

Drug.	Beginning action. min.	Time of		Maximum extent of action. mm. Hg.	%
		Maximum effect. min.	Duration of action. min.		
Amyl nitrite, 3 min. (0.20 c.c.)..	1	3	7	15	11
Nitroglycerin, 1½ min. (0.10 c.c.), 1 per cent. sol.	2	8	30	15	11
Sodium nitrite, 1 gr. (0.06 Gm.).	10	25	60	14	13
Erythrol tetranitrate, ½ gr. (0.03 Gm.)	15	32	120-240	16	14

AVERAGE BLOOD-PRESSURE RESULTS IN PATIENTS WITH ARTERIOSCLEROSIS.

Drug.	Beginning action. min.	Time of		Maximum extent of action. mm. Hg.	%
		Maximum effect. min.	Duration of action. min.		
Nitroglycerin, ⅓ gr. (0.002 Gm.)	2	8	35	32	17
Sodium nitrite, 2 gr. (0.13 Gm.).	15	45	120	53	25
Erythrol tetranitrate, 2 gr. (0.13 Gm.)	30	60	180	60	30

acteristically prompt action of amyl nitrite, used by inhalation, is not obtained from it.

Report of a comparative study of the nitrite group in normal individuals and hospital patients. Amyl nitrite was given by inhalation; nitroglycerin, sodium nitrite, and erythrol tetranitrate, by mouth.

With amyl nitrite the authors not infrequently saw a rise instead of a fall of pressure. This occurred if the dose was small, and means a marked capability of the vascular system to retain its equilibrium.

In normal individuals headache is especially severe after erythrol tetranitrate, and may last for many hours after the pressure has returned to its original level. Headache is rarely induced by these drugs if the beginning pressure is abnormally high; in fact, an existing headache not infrequently disappears as the pressure falls.

One patient was given ⅛ grain (0.008 Gm.) nitroglycerin. The pressure dropped from 210 mm. to 60 mm. in ten minutes,—a fall of 150 mm. Hg, or 71 per cent. Four minutes later it was up to 168 mm., and within fifty minutes the pressure was back to its original point. The only symptom was faintness of a few

minutes' duration. To another patient 6 grains (0.4 Gm.) sodium nitrite were given. The pressure fell from 210 to 100 mm. Hg, a fall of 52 per cent. The fall in pressure is rather directly proportional to the dose taken. Only in cases in which the splanchnic vessels are no longer capable of dilatation will a fall not occur. G. B. Wallace and A. I. Ringer (Jour. Amer. Med. Assoc., Nov. 13, 1909).

Nervous System.—No direct action on nervous tissue is exerted by the nitrites, but the marked vasodilatation in the cerebral vessels, in conjunction with the fall in blood-pressure, may lead to headache, dizziness, faintness, blurring of vision, and even, after large doses, convulsive manifestations. Initial stimulation of the medullary centers through irritation of the nasal mucous membrane may result from amyl nitrite inhalation, a temporary rise in blood-pressure and inhibitory slowing of the heart therefore taking place. Nerve-endings, *e.g.*, those of the vagus or of the motor nerves to striated muscle, are apparently uninfluenced by the nitrites.

Respiration.—The breathing is not infrequently rendered deeper and more frequent by the nitrites, the respiratory centers seemingly stimulated. In the case of amyl nitrite, momentary arrest of respiration may precede, owing to irritant impulses transmitted to the respiratory centers from the nasal mucosa.

Muscles.—A relatively important effect of the nitrites is that of depressing the involuntary muscle-tissue in the bronchial tubes. Though not as pronounced as the effect on the vascular musculature, this action is sufficiently powerful to be of utility in bronchial asthma. A possible muscle-relaxing effect of the nitrites in spasm of the bile-duct or ureter is also recognized.

Kidneys.—The effect of the nitrites upon urinary excretion is inconstant, as several factors may be simultaneously operative. A fall in general blood-pressure in itself tends to reduce the urinary output. On the other hand, if a nitrite be given when the renal vessels are too greatly narrowed to permit of a maximum urinary output, their effect in dilating these vessels may improve the renal function, in spite of the reduction in general blood-pressure. The nitrites are thus, at certain times, capable of producing a distinct diuresis.

Temperature.—This may be somewhat lowered, because of the peripheral vasodilatation and consequent increase in heat loss.

Blood.—Taken into the system in very large amounts, or placed in contact with blood in a test-tube, the nitrites cause the blood to assume a more or less pronounced chocolate color, owing to alteration of some of

the hemoglobin into methemoglobin and nitric oxide hemoglobin. The oxygen-carrying power of the blood is thus for a time reduced, though this effect is never sufficient, even after decidedly large therapeutic doses, to cause any serious symptoms. In animal experiments, on the other hand, it has been found possible actually to produce death through excessive alteration of the blood brought on by copious administration of the nitrites.

Absorption and Elimination.—The relative rapidity of absorption of the nitrites has already been considered. The changes undergone by the drugs in the body remain to be discussed. Amyl nitrite, after absorption, does not continue to circulate as such, but is soon decomposed, with formation, first, of nitrites of the alkalies; then, of a certain proportion of alkali nitrates, produced from the nitrites by oxidation. The urine contains a portion of these nitrites, while the breath may contain an unoxidized residuum of the amyl constituent of the original amyl nitrite.

Sodium nitrite, taken by the mouth, is in part decomposed by the hydrochloric acid of the gastric juice, nitrous acid being liberated. This acid, in turn, is itself broken up with liberation of gases which may lead to eructations and irritation of the alimentary tract. Most of the sodium nitrite, however, enters the blood unchanged, part of it, as in the case of amyl nitrite, being then oxidized to nitrates, which later appear in the urine. Amyl nitrite, if taken by mouth, is decomposed in the stomach with even greater readiness than sodium nitrite, and for this reason acts much less strongly than when

inhaled. Subcutaneous injection is also an unfavorable route for the administration of amyl nitrite, the effect being delayed and feeble.

Nitroglycerin is not broken down by the gastric juice, but upon entering the circulation is, for the most part, promptly split up into nitrites, nitrates, and glycerin, the former immediately initiating, and thereafter continuing for some time, the typical nitrite action. The behavior of erythrol tetranitrate and mannitol hexanitrate in the system is, as far as known, similar to that of nitroglycerin.

UNTOWARD EFFECTS AND POISONING.—Overdoses of the nitrites cause headache, at times with tinnitus and dizziness. After distinctly toxic amounts, there are likely to occur, in addition, such effects as cardiac palpitation with a rapid, full pulse, markedly flushed face, throbbing in the head, a sense of peripheral heat, and rapid respiration; also, occasionally, xanthopsia or yellow vision. Vomiting and diarrhea are likewise possible symptoms. Some mental confusion may be present, and eventually motor weakness, loss of reflexes, together with stupor, supervene. The heart action becomes slow, the respiration shallow and frequently irregular, and cyanosis appears. Convulsive movements may be noted, but death, which takes place in experimental animals, by respiratory failure, has not been reported in man.

Some individuals have been observed to respond very markedly to small amounts of the nitrites, falling into a syncope, with slowing of the heart. Inhalation of 5 minims of amyl nitrite has been known to cause fainting. Other patients, on the other

hand, show an unusual tolerance to these drugs. In one case, recorded by Stewart, 20 grains (1.25 Gm.) of nitroglycerin taken in one day exerted but little action.

Continued severe headache is said to be most common after the use of nitroglycerin and erythrol tetranitrate. Methemoglobinuria and other manifestations of nitrite poisoning have followed the administration by mouth or rectum, or the injection into sinuses, for radiographic or therapeutic purposes, of bismuth subnitrate.

Description of the symptoms of nitroglycerin poisoning as observed in dynamite factories, etc. Effects are liable to be produced by even slight contacts with clothing, etc., of the workers, in susceptible individuals. The headache is the most distressing symptom. All workers in the substance experience some inconveniences,—dyspnea, tachycardia, and genitourinary disturbances,—but it does not seem to affect seriously the general health in those habituated. Treatment is generally unsatisfactory in the severe cases, and acquired immunity is soon lost. C. E. Laws (Jour. Amer. Med. Assoc., March 5, 1910).

Report of cases of poisoning met with among workmen who were accustomed to the daily handling of nitroglycerin, some of which were fatal, and all productive of serious symptoms, such as headache, vomiting, jaundice, and optic atrophy. The symptoms are quite varied. It is hard to detect the presence of the poison in the body chemically on account of its volatile character, and, with the exception of the changes in the blood, which can be made out with certainty only with the spectroscope, there are practically no organic changes. For treatment of the acute symptoms, **fresh air** and **oxygen inhalations**, if necessary, are indicated. R. R. Pirrie (Practitioner, Feb., 1912).

Treatment of Poisoning.—If a nitrite has been taken internally in toxic amount, the **stomach** should be **evacuated** by means of the **stomach-tube** or an **emetic**. **Strychnine**, **epinephrin**, **ergotin**, **digitalis**, and **cocaine** are suitable physiological antidotes for hypodermic use. In a case reported by Schilling, subcutaneous injection of 16 minims (1 c.c.) of a 5 per cent. solution of **cocaine** led to subsidence of the worst symptoms of the poisoning in a few minutes, and their complete disappearance in a quarter of an hour. The **recumbent position** is advisable, to ease the work of the heart working at a mechanical disadvantage. **Cold applications** may be made to the **head**. An abundance of **fresh air** should be supplied, and **artificial respiration** instituted when the occasion presents.

In poisoning from nitrous gases, *e.g.*, from sawdust being strewn on spilt nitric acid, the main symptoms are in the throat and lungs at first; as these subside in the course of a few weeks, extreme debility, emaciation and nervous symptoms follow and are apt to be permanent. Out of 20 firemen who were seriously poisoned by fumes during the burning of a chemical works, 11 were permanently incapacitated and 1 died. No means of effectual treatment are known; **heart tonics** may be needed, and diluted **lime-water** or other **alkaline water** have been recommended, as also **inhalations of oxygen**, **ammonia**, **sodium bicarbonate spray**, or **venesection** plus **saline infusion**. Some recommend from 3 to 5 drops of **chloroform** in a glass of water taken every ten minutes, until the maximal dose of 1.5 Gm. (23 grains) has been taken in the course of one or two hours. Tetzner (Med. Klinik, April 26, 1914).

THERAPEUTIC USES.—The chief uses of the nitrites is as direct

depressants to involuntary muscle-tissue, especially that of the blood-vessels.

In **chronic nephritis** with **high arterial tension** the nitrites are frequently used to reduce vascular tone and ease the work of the heart. Although it is not regarded advisable to lower the blood-pressure to normal in these cases, certain organs apparently requiring the greater supply of blood which the high pressure affords, the nitrites are likely to prove beneficial, at least for a time, by avoiding excessively high pressures which tend to induce such symptoms as headache, flushes, tinnitus, dyspnea, etc. Limitation of the nitrogenous intake and maintenance of free action of the skin and bowels are, of course, not to be neglected as remedial measures.

Too readily acquired tolerance to nitroglycerin is not rare. In 1 case 20 minims (1.25 c.c.) of pure nitroglycerin were taken daily. The patient had not been encouraged to increase the dose beyond an amount sufficient to produce more than a slight feeling of fullness in the head. When it is desired to employ this drug for a considerable period, for its effects on blood-pressure, the intervals between doses should be comparatively short—never less than four times daily. If enough is always taken to produce a marked immediate result, such as flushing and slight headache, tolerance is soon acquired. When a rather rapid increase seems necessary in order to maintain a constant effect, an important point is temporarily to discontinue the drug for two or more days, at intervals of two or three weeks. On its resumption, a much smaller initial dose will be required than that last taken. The author rarely exceeds a dose of 10 drops of the 1 per cent. solution, and when for the initial dose of 1 drop tolerance to the larger dose is apparent, the drug

is temporarily discontinued. It is important simultaneously to restrict the nitrogenous intake, and occasionally to use a mercurial purge, or, more frequently, salines. Aconite may often be substituted for nitroglycerin with advantage. D. D. Stewart (Jour. Amer. Med. Assoc. May 27, 1905).

The nitrites have no permanent influence on habitual **hypertension** and should not be used systematically for this purpose, as they would thus lose their power when needed at a critical moment. Spirit of nitrous ether is the only one of the group to which the above does not apply; this drug is more of a general sedative for the circulatory system than a reducer of tension, and it does not contraindicate the use of the other preparations at need. The writer advocates it in doses of 2 to 4 Gm. (30 to 60 minims) a day, in divided doses, kept up for a long time. But when occasionally prompt action is necessary the organic nitrites must be called on. Nitroglycerin is regarded by the writer as the one remedy for **angina pectoris** and **paroxysmal edematous dyspnea** in persons with **arterial hypertension**. H. Vaquez (Arch. des mal. du Cœur, des Vaisseaux et du Sang, Jan., 1908).

In health amyl nitrite relaxes the arteries with a very slight drop in the diastolic blood-pressure. The blood-pressure returns at once to normal on its removal. In **arteriosclerosis** the diastolic blood-pressure drops considerably, although the heart action may be stronger. On removal of the drug the blood-pressure does not return to its former height until after half an hour. The writer has the patients inhale 10 drops of amyl nitrite at once, and has never witnessed any threatening symptoms from it in several hundred experiments on healthy subjects. He has also found it effectual in the treatment of **tuberculous hemoptysis**. C. v. Rzentkowski (Zeitsch. f. klin. Med., Bd. lxxviii, Nu. 1-2, 1909).

Sclerosed vessels are abnormally susceptible to spasm. The degree to which high arterial pressure can be lowered by the nitrites depends largely upon the amount of vascular spasm present; in most cases **arterial spasm** and fibrosis are associated. W. J. Conklin (Ohio State Med. Jour., June 15, 1910).

In **angina pectoris** amyl nitrite is administered by inhalation, in doses of 2 to 5 minims (0.12 to 0.3 c.c.), ostensibly for the purpose of relaxing the coronary arteries, sometimes found sclerosed in this condition. Recent observations seem to have shown, however, that the actual seat of origin of the pain in **angina pectoris** is the aorta, which is dilated through a temporary increase in cardiac activity, and presses upon the nerve-plexuses surrounding it. If this view be accepted, the drug presumably relieves the pain by reducing the pressure in the aorta through dilatation of the peripheral vessels. Murrel has advocated the use of nitroglycerin in **angina pectoris**; to favor rapid absorption of the drug he administers it in the following mixture:—

℞ *Spiritus glycerylis nitratis*,
Spiritus chloroformi, āā f3ss (2 c.c.).
Tinctura capsici f3j (4 c.c.).
Aquæ menthæ piperitæ,
 q. s. ad f3j (30 c.c.).

M. Sig.: One dram (4 c.c.) every four hours, with an extra dose immediately at the onset of an attack.

In certain cases of valvular heart disease, *e.g.*, in **aortic insufficiency** with **excessive hypertrophy** and severe frontal headache, sodium nitrite or nitroglycerin may at times be employed with advantage to reduce the resistance offered to the heart in the vascular system. In **cardiac dyspnea**

the nitrites may prove of value; care should be taken not to exceed moderate doses, however, where fatty disease of the heart is suspected. Parker points out that $\frac{1}{200}$ grain (0.0003 Gm.) of nitroglycerin is often sufficient to relieve **cardiac asthma**; in fact, success from doses as small as $\frac{1}{1000}$ grain (0.00006 Gm.) has been reported.

Nitroglycerin should never be used primarily as a heart stimulant. When placed under the tongue its effects are as prompt as when injected subcutaneously. If given too long or in too large doses it can produce injurious effects, which, however, disappear when the remedy is discontinued. E. E. Cornwall (Jour. Amer. Med. Assoc., July 12, 1913).

Some of the cases in which nitroglycerin has proved very successful are: (1) **cardiac irritability** and **palpitation** due to tobacco; (2) **double aortic lesions** complicated by intense paroxysms of **angina pectoris**; (3) **aortic stenosis** with weak heart and severe breast pain; (4) simple **cardiac palpitations** of **neurotic origin**; (5) **chlorotic anemia** with seizures of intense **thoracic angina**. Stanley Eiss (Amer. Pract., May, 1914).

In **localized spasms of the vessels**, such as are present in **Raynaud's disease** and **erythromelalgia**, the nitrites sometimes prove of service, given in gradually increasing doses.

Attention called to the value of nitroglycerin in surgical cases, administered in doses of $\frac{1}{100}$ grain (0.00065 Gm.). He advises its use in incipient **senile gangrene**, and in all cases of impaired circulation in which **contracted arterial walls** are present. Even when the arteries seemed to be normal the author has used the drug with benefit in **local congestion**. Elvy (Brit. Med. Jour., Jan. 7, 1905).

Rigors are accompanied by peripheral vasoconstriction and are frequently relieved by inhalations of

amyl nitrite. The relief of **syncope** is explained in the same way. F. Hare (Clinical Journal, August 29, 1906).

In the **syncope** and **cardiac depression of chloroform anesthesia**, reports of a successful use of amyl nitrite have been made. The action of the drug in these cases apparently consists in a relaxation of the vessels, whereby the work of the greatly depressed heart is facilitated and the organ permitted gradually to resume its functions as the chloroform is destroyed or excreted. Bastedo was able with amyl nitrite to restore mice apparently nearly dead from chloroform. In the first and second stages of general anesthesia; either with chloroform or ether, amyl nitrite, according to Mühlberg and Kramer, will prevent the cessation of heart action sometimes resulting from the action of these two drugs alone.

Among the respiratory conditions in which the nitrites are used is **bronchial asthma**. Here the burning of potassium nitrate, generally in combination with belladonna or one of its congeners, tends to dilate the constricted bronchi through its conversion from a nitrate to nitrous acid or a nitrite during combustion, whence a bronchodilatation is produced through the direct action of the drug on the muscle-tissue of the arterioles. Early in the attack, inhalation of a few minims of amyl nitrite will be found useful. Its evanescent effect can be prolonged by the administration of sodium nitrite, nitroglycerin, etc.

In **hemoptysis**, occasional good results have been reported by various observers, from the administration of the nitrites of amyl and sodium. Placek, while recognizing the fact

that they seem contraindicated in cases with erosion of a large vessel or where a small aneurism has ruptured, does not hesitate to recommend the remedy in other instances, adding, moreover, that determination of the blood-pressure is important as an aid both in the prevention and the treatment of hemoptysis.

Amyl nitrite used fifteen times in 7 cases of **hemorrhage from tuberculous lungs**. Each time the drug exerted a prompt action. The hemorrhage was arrested and blood ceased to accumulate in the bronchial passages. Five or 6 drops of amyl nitrite were inhaled on a wad of cotton. The hemorrhage did not recur in the majority of cases. The inhalations were repeated several times afterward during the day. The nitrite was supplemented by the slower action of an enema of gelatin to which calcium chloride had been added, together with fluid extract of hydrastis internally. A. Braga (*Gazzetta degli Ospedali*, Dec. 22, 1907).

In **hemoptysis** amyl nitrite acts instantly, producing a fall in blood-pressure and giving time for clotting to take place. It does not interfere with coughing, and so permits the patient to get rid of the effused blood. Capsules can be easily carried by the patient, who can then inhale the contents of one as soon as hemoptysis begins, thus treating the condition at once and often preventing a worse attack. G. A. Grace-Calvert (*Brit. Jour. of Tuberculosis*, July, 1908).

In certain nervous disorders, more especially those characterized by **muscular spasm**, the nitrites are sometimes useful. Thus, in **epilepsy**, inhalation of amyl nitrite during the aura will tend to ward off the imminent paroxysm, and in **hystero-epilepsy** and **hysterical seizures** in general the attacks may be cut short by repeated inhalations of the same

remedy. In **tetanus**, during the severe paroxysm of muscular spasm often present while the patient is being fed, inhalation of a few drops of amyl nitrite may avert death by relaxing the tonic spasm of the respiratory muscles. In obstinate **hiccough** amyl nitrite may also prove of service.

Migraine attended by angiospasm, **headache** and other symptoms due to **cerebral anemia**, are not infrequently relieved by amyl nitrite inhalation. According to Loomis, the **vertigo of seasickness** may be similarly relieved upon the first appearance of the nausea. Osler is credited with the statement that in **tabes dorsalis** the continued use of nitroglycerin will relieve the neuralgic pains and lessen the frequency of the painful crises. According to H. E. Lewis, in **sciatica**, 2 minims (0.13 c.c.) of spirit of glyceryl trinitrate combined with morphine will frequently give relief where the morphine used alone is unsuccessful. In cases of **cyanosis** with venous congestion, a small, high-tension pulse and cephalic symptoms due to intracranial vascular disturbance such as dizziness, periods of unconsciousness, aphasia, and perhaps a paretic condition of one or more extremities, Gordon has pointed out the value of $\frac{1}{100}$ grain (0.0006 Gm.) of nitroglycerin, given two or three times a day.

The nitrites reduce vascular tension especially in the **incipient** or presclerotic stage of **arteriosclerosis**. In cases of presclerosis (early arteriosclerosis), nitroglycerin may be given for ten days, and followed by theobromine for ten days. Some success has been recorded from its use in **anemic vertigo**, or **Ménière's disease**. *Erythrol tetranitrate* is less effective

than nitroglycerin, but its action is more lasting. It is especially indicated in subjects of angina pectoris who are awakened in the night by the pains. *Sodium nitrite* yields less satisfactory results than the two latter-named. Huchard and Fiessinger (Jour. des praticiens, Dec. 11, 1909).

In **cholera infantum** with pronounced nervous symptoms, or when the skin becomes cold and clammy, Lewis deems nitroglycerin a life-saver when given in doses of $\frac{1}{250}$ grain (0.00026 Gm.) frequently repeated.

The **reflex vasomotor disturbances of the menopause and of the menstrual periods**, manifested by such symptoms as mental depression, cold hands and feet, unaccountable flushings, hysterical phenomena, and at times pain, can be relieved, at least temporarily, by nitroglycerin, employed internally in small doses. The **neuralgia accompanying dysmenorrhea** can be promptly relieved by the inhalation of a few drops of amyl nitrite.

Case of a multipara, aged 56, suffering from an excessive **menorrhagia**, which kept her chronically anemic, in which inhalation of amyl nitrite was followed by complete arrest of hemorrhage, and with stoppage of the menstruation in twelve hours. On several later occasions excessive flow was stayed by inhalations of this drug. Colman (Scottish Med. and Surg. Jour., May, 1905).

Given in doses of $\frac{1}{200}$ grain (0.0003 Gm.), hypodermically, with **morphine**, nitroglycerin prevents the **nausea** usually produced by the latter agent (Eiss).

In poisoning by certain drugs, amyl nitrite may be used with some expectation of useful effects. Rüdsky reported a case of **acute cocaine poison-**

ing in which the cyanosis and pallor of the face almost instantly disappeared, the respiration became freer, and the pulse fuller and slower, after amyl nitrite had been inhaled. Wood showed that the same drug has some power to allay the exaggerated spinal reflex action in **strychnine poisoning**. In **opium habit** the placing of a few drops of spirit of glyceryl trinitrate upon the tongue is asserted to have proven efficient in temporarily removing the craving for the narcotic drug.

In the mild **febrile affections of children**, spirit of nitrous ether in doses of 10 or 20 minims (0.6 or 1.25 c.c.) is of recognized utility in overcoming **oliguria** due to fever or acute congestion of the kidneys. A diaphoretic effect may be procured in place of the diuresis if warm coverings be placed around the patient. The same preparation may be used in adults where a mild but fairly continuous vasodilator action is desired. For diaphoretic purposes in adults it may be given in hot water in 20- or 30- minim (1.25 or 2 c.c.) doses every half-hour. It may also be used as a carminative in **flatulence**.

Abrams has utilized the bronchodilator action of amyl nitrite for **diagnostic purposes** in certain **respiratory affections**.

In some forms of **bronchitis spasm** may be an element in the dyspnea, and conversely a catarrhal factor may complicate an attack of asthma. Amyl nitrite by inhalation removes the dyspnea, if occasioned by spasm, but does not influence it if dependent on bronchitis. To distinguish the râles caused by bronchitis from those of asthma, one should auscult the chest after amyl nitrate inhalation; the râles of the former persist, while those of the latter are dissipated.

Albert Abrams (Med. Fortnightly, Aug. 25, 1900).

C. E. DE M. SAJOUS.

AND

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NITROBENZENE.—Nitrobenzene (nitrobenzol, essence or oil of mirbane, artificial oil of bitter almonds) is an almost colorless, oily liquid, having a sweet taste and the odor of bitter almonds. It is used as a cheap substitute for the true essence of bitter almonds; it is never used medicinally and is of interest solely on account of its toxicity.

POISONING BY NITROBENZENE.

—The diagnostic features are the odor, cyanosis, and asphyxia. Methemoglobinemia is present, the blood becoming chocolate-colored, very thick, and viscid. The pupils are dilated; the respiration rapid, irregular, and shallow; the pulse accelerated, thready, and, later, imperceptible. The temperature becomes subnormal. The muscles relax; consciousness may be lost. Nine drops have caused death. Poisoning may occur by inhalation or by internal use.

Treatment of Poisoning.—In poisoning by *inhalation* use cold applications to the head, warmth to the trunk and extremities (hot-water bags or bottles), stimulants (internal and external, including electricity), hypodermics of strychnine, massage, artificial respiration (prolonged until normal respiration is established).

If the poison has been taken *internally*, in addition to the above, emetics, followed by gastric lavage, liberal doses of hydrated oxide of iron, whisky, and diluted ammonia; oxygen inhalations and the free use of liquids are indicated. A pint (500 c.c.) of blood withdrawn by venesection and replaced by normal saline solution will hasten recovery. W.

NITROUS OXIDE.—Nitrous oxide gas (nitrogen monoxide, "laughing gas") was discovered by Priestley, and its anesthetic properties recognized by Humphry Davy in the beginning of the nineteenth century.

Not until about forty years later, however, in 1844, was the compound employed for practical anesthetic purposes by Horace Wells, a dentist of Hartford, Conn.

Nitrous oxide, N_2O , is a colorless gas, heavier than air, of neutral reaction, and with a slightly sweetish taste and odor. It dissolves in an equal volume of water and can easily be liquefied by pressure. It is not itself inflammable, but liberates oxygen in the presence of burning substances, the combustion of which it thus supports. The combustion of carbon and phosphorus is fostered by it almost as well as by oxygen gas, but at the relatively low temperature of the human body it fails to give up its oxygen, thus being without efficiency as a supporter of oxidation in living tissues.

Nitrous oxide may be made by gradually heating ammonium nitrate [NH_4NO_3],—or preferably a well-dried mixture of ammonium sulphate and sodium nitrate—to $250^\circ C$. in a retort or flask; the nitrate is thus decomposed into nitrous oxide and water. The gas is then freed from any trace of chlorine and nitric oxide by passage through warm solutions of caustic alkali and of ferrous sulphate, and collected over hot water. Liquefied by pressure, the gas is supplied in cylinders, from which it issues again in the gaseous state as soon as pressure is released. Fifteen ounces of the liquid nitrous oxide yield 50 gallons of the gas.

PHYSIOLOGICAL ACTION.—

Locally, nitrous oxide is devoid of irritant power.

General Effects.—**NERVOUS SYSTEM.**—Although many early observers held that nitrous oxide exerted its

anesthetic effect merely through exclusion of oxygen from the central nervous system, the nervous tissues being placed in a condition of partial asphyxia owing to the cessation of oxygen intake in respiration, it has since been proven in various ways that nitrous oxide *per se* exerts a distinct depressant action upon the brain centers.

Paul Bert has demonstrated very clearly the narcotic action of nitrous oxide in experiments both on animals and man. Observing that inhalation of a mixture of 80 per cent. of nitrous oxide with 20 per cent. of air caused only imperfect anesthesia, while pure nitrous oxide caused asphyxia, he contrived, by administering a mixture of 80 per cent. of nitrous oxide and 20 per cent. of oxygen at a pressure one-fourth higher than the ordinary atmospheric pressure to animals in a glass case, to make these animals absorb as much nitrous oxide as if they were breathing it pure at the ordinary pressure, and also as much oxygen as if they were breathing air. In spite of the complete absence of asphyxia afforded by this procedure, complete anesthesia was noted, which anesthesia could be kept up with impunity for three days. Goldstein found that frogs, which are capable of resisting asphyxia for one or more hours in non-sustaining gases such as hydrogen and nitrogen, become narcotized in a few minutes when placed in nitrous oxide. Clinically observed phenomena suggestive of the same fact, viz., that nitrous oxide anesthetizes through a special depressant action on the nerve cells and not through asphyxia, are enumerated by Parsons as follows: (1) the induction of analgesia before cyanosis ap-

pears when the gas is inhaled pure; (2) the fact that when nitrous oxide is combined with proper percentages of oxygen, with the patient showing even an overpink color, anesthesia is profound and satisfactory; (3) the fact that characteristic symptoms of anoxemia are not present during a correct gas-oxygen anesthesia. The customary asphyxial convulsions occurring at the end of about a minute in warm-blooded animals, with artificially occluded respiratory passages, fail to occur in well-marked form where pure nitrous oxide is instead administered—again demonstrating a narcotic effect of this gas on the nerve-centers.

It has been held, partly owing to the experiments of Wood and Cerna, who showed that even merely a 3 per cent. addition of oxygen to nitrous oxide delayed considerably the anesthesia, that asphyxia is a distinct contributing factor in the narcotic effect of nitrous oxide. That such asphyxia is not a necessary, but rather an adventitious and unwelcome factor in the ordinary clinical action of nitrous oxide is, however, now considered established.

Animals under nitrous oxide narcosis resisted shock-producing trauma far better than did other animals. Also in animals reduced by infections, hemorrhage or hyperthyroidism, nitrous oxide showed a marked advantage over ether. The change in the ganglion cells of the central nervous system from the cortex to the cord showed a distinct difference between the cells in the ether and nitrous oxide animals, there being much less change in the former. The rôle of shock and infection is far less in nitrous oxide than in ether anesthesia, and there is a distinct diminution in postoperative neurasthenia. G. W. Crile (So. Med. Jour., Jan., 1910).

CIRCULATION.—Nitrous oxide exerts little or no direct effect on the cardiovascular system. Indirectly, however, it tends to increase the blood-pressure and slow the pulse rate, through stimulation of the vasomotor and vagus centers in the medulla, respectively, when an asphyxial condition of the blood has been produced. The pulse is not so slow as in ordinary asphyxia, according to Cushny, because the vagus centers are rendered less active than usual by the nitrous oxide.

BLOOD.—Nitrous oxide dissolves in the blood without combining in any way with hemoglobin. It therefore fails to impair the oxygen-carrying power of the blood, as would be the case with carbon monoxide (coal gas), and is readily eliminated through the lungs as soon as inhalation of it is discontinued.

RESPIRATION.—The respiratory centers are slightly depressed by nitrous oxide itself, but become temporarily stimulated by carbon dioxide if an asphyxial condition of the blood is produced through the exclusion of oxygen.

METABOLISM.—Glycosuria has in occasional instances been noted after nitrous oxide inhalation. This is considered due to the accompanying asphyxia, not to the anesthetic gas itself.

NITROUS OXIDE AS AN ANESTHETIC.—Nitrous oxide is by far the safest of all anesthetics, only a few deaths having been recorded in millions of anesthetics in which it was employed. Other pronounced advantages are the prompt anesthesia produced and the rapidity of recovery; the absence of vomiting and of respiratory and renal irritation; the

lack of deleterious influence on phagocytosis, and the fact that the danger of untoward results is not increased by frequently repeated administrations. The chief disadvantage in the use of pure nitrous oxide, the briefness of anesthesia, is removed by combination of a suitable proportion of oxygen with the nitrous oxide, as described in a special section at the close of this article.

In addition to its extensive use by dentists for the painless extraction of teeth, pure nitrous oxide is also employed for surgical operations of short duration, as in opening abscesses, boils, or felons, closing sinuses, simple dilatation and curetment, breaking up joint adhesions, reducing fractures and dislocations. In the weak, aged, anemic and very young it is best administered with oxygen. In brief operations it is usually the anesthetic of choice. It has been used to induce anesthesia prior to the administration of ether or chloroform, thus reducing the time of induction and diminishing the amount of the more dangerous liquid anesthetic required for the operation.

A series of 135 labor cases in which nitrous oxide was used, showed that the gas is a safe analgesic in childbirth. It can be administered by the patient to herself under supervision or by any competent trained nurse with slight instruction. One or two good breaths of the gas should be taken before the full strength of the pain is felt. The method is especially suitable in cases with severe, prolonged pains. In over 80 per cent. of the cases the uterine contractions were either not changed or strengthened by it. G. H. Ryder (*Amer. Jour. of Obstet.*, June, 1917).

CONTRAINDICATIONS.—Circulatory abnormalities constitute the

most frequent contraindication to nitrous oxide, which is to be avoided both in well-marked atheroma, especially if high blood-pressure coexists, and in cardiac dilatation, with or without a valvular lesion. Mitral stenosis, aortic regurgitation, and the "beer heart" are generally held to contraindicate nitrous oxide, as does also the combination of high blood-pressure with a weak cardiac first sound. Buxton regards the anemic individual, the "overgrown" boy; the nervous, sensitive child subject to fainting; the child with congenital cyanosis, and the person with an hypertrophied heart as among the most dangerous types of individuals for nitrous oxide, syncope and asphyxia easily occurring in these cases. With care to obviate struggling and undue exclusion of air or oxygen, however, no absolute contraindication to gas anesthesia is presented even in these cases.

Marked respiratory embarrassment, especially if due to a swelling which will be made worse through venous congestion, contraindicates nitrous oxide anesthesia, but if the dyspnea be of minor extent, as is frequently the case in patients with tonsillar swelling, Ludwig's angina, glandular or other enlargements exerting pressure on the respiratory channels, enlarged thymus, large adenoid growths, intra-abdominal effusions or growths pressing on the diaphragm and heart, obesity, pleural adhesions, and general affections causing dyspnea, nitrous oxide may be used provided great care be taken to avoid all asphyxia during the anesthesia.

In the aged, intolerance of asphyxia and circulatory stress is likewise a feature to be remembered, especially

if chronic bronchitis is present; nitrous oxide anesthesia is not, however, contraindicated by old age *per se*. In pregnant women it should be borne in mind that excessive exclusion of air may injure the fetus or bring on labor, while in children marked jactitation results from similar carelessness in the use of the anesthetic.

Nitrous oxide cannot be relied upon to bring about general muscular relaxation, unless administered in combination with oxygen by an experienced anesthetist.

CHARACTERISTIC PHENOMENA OF NITROUS OXIDE NARCOSIS.—Inhalation of a mixture of nitrous oxide and air produces a condition of hilarity, motor disturbance, and partial insensibility which led to the popular application of the term "laughing gas" to nitrous oxide. If the mixture inhaled be one of 4 parts of nitrous oxide with 1 part of oxygen, a similar state is occasioned, in which the subject experiences a drumming sensation in the ears, indistinctness of vision, and a general feeling of warmth. Motor inco-ordination, laughter, hypesthesia, and at times drowsiness appear, but complete unconsciousness and loss of peripheral sensibility never occur.

If inhaled pure, as is customary in clinical work, through a close-fitting mask, nitrous oxide produces, after a period of induction averaging about fifty-five seconds, complete anesthesia lasting forty to forty-five seconds in ordinary adults and about 30 seconds in anemic persons and children. During the period of induction the subject may experience some of the symptoms already mentioned. At times, however, a condition of hyper-

esthesia precedes the anesthesia, and during this brief period hallucinatory impressions may be received that will remain firmly fixed in the brain upon recovery from the narcosis. During the initial moments of impaired consciousness, painless extraction of a loose tooth may be effected, though the patient has a vague idea that something is being done. A few seconds later, complete unconsciousness is established. The face, at first flushed, then pale, in

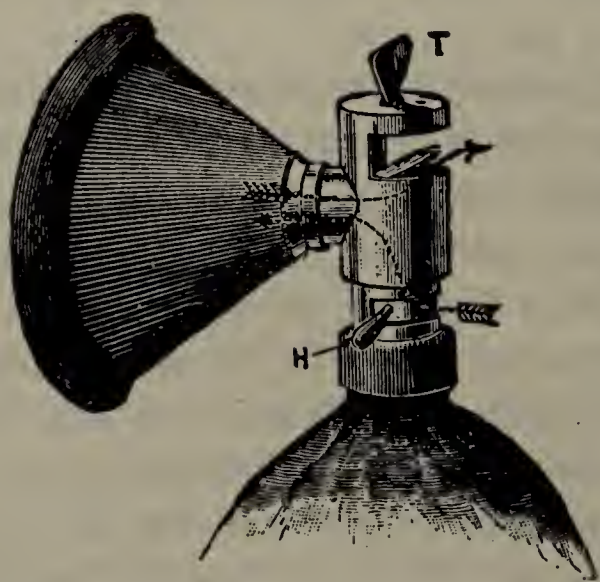


Fig. 1.—Face-piece, stopcock, and gas-bag for the administration of nitrous oxide gas only. (Sir F. Hewitt's apparatus.) The handle, *H*, opens or closes the air-way while it closes or opens the supply of gas from the bag. The tap marked *T*, when rotated, closes the expiratory valve and allows of rebreathing. The arrows indicate the course followed by air or gas.

about twenty seconds after the first inhalation, becomes slightly cyanotic (eyelids, cheeks, and ears), especially in florid persons. The heart action, at first fairly rapid, becomes slower—though still regular and full—as the narcosis deepens, while the respiration likewise slackens and, when anesthesia is complete, may be slightly stertorous. The muscles may partially relax, but in many instances jactitation of the extremities sets in, presumably owing to the deprivation of oxygen, and where asphyxia is permitted to attain a certain degree mani-

fest rigidity appears. In children jactitation appears with special readiness and promptness. The superficial reflexes are lost under nitrous oxide, but the knee-jerk and occasionally the conjunctival reflex, persist. Wide dilatation of the pupils generally accompanies complete anesthesia, no indication of danger—as in the case of ether—being, however, thereby presented. When the inhalation is stopped, recovery quickly occurs, almost invariably without nausea or any other unpleasant after-effect.

METHOD OF ADMINISTRATION.—Preparation of the Patient.—Although nitrous oxide is often employed with success where there has been no particular preparation of the subject, abstention from food for some hours before the anesthesia is desirable. Belts, corsets, and collars should be loosened, and—especially in children—the bladder emptied before induction is begun.

Posture.—The subject should be so placed that the muscles are relieved of all tension and the respiration and circulation free of all hindrance. This is best attained by having him seated in a chair with head-rest, with his legs hanging freely, the trunk somewhat extended on the pelvis, and the head in a line with the body.

Apparatus.—This commonly consists of a pair of cylinders containing liquefied nitrous oxide, connected by tubing with a rubber gas-bag capable of holding 2 or 2½ gallons of gas. To the upper end of the bag is directly attached by a T-shaped metallic mount, provided with inspiratory and expiratory valves, a conical or rounded face-piece, which should fit accurately round the subject's mouth and nose. The metallic mount re-

ferred to is available in several forms, among the best known being Hewitt's and the three-way stopcock form (see Figs. 1 and 2). In each the object of the device is to provide for three possibilities, according to the condition of the slots in the metallic mount, viz., the patient may be made either to inspire and expire air, to inspire gas and expire it into the atmosphere, or to inspire gas and ex-

pire nitrous oxide. Only one cylinder is drawn upon at a time, the second being reserved for when the first has been emptied; the first should then be at once replaced.

Administration.—The anesthetizer should begin by testing the apparatus to make certain that the valves are in good working order and that the gas passes into the bag freely. Upon application of the face-piece to the

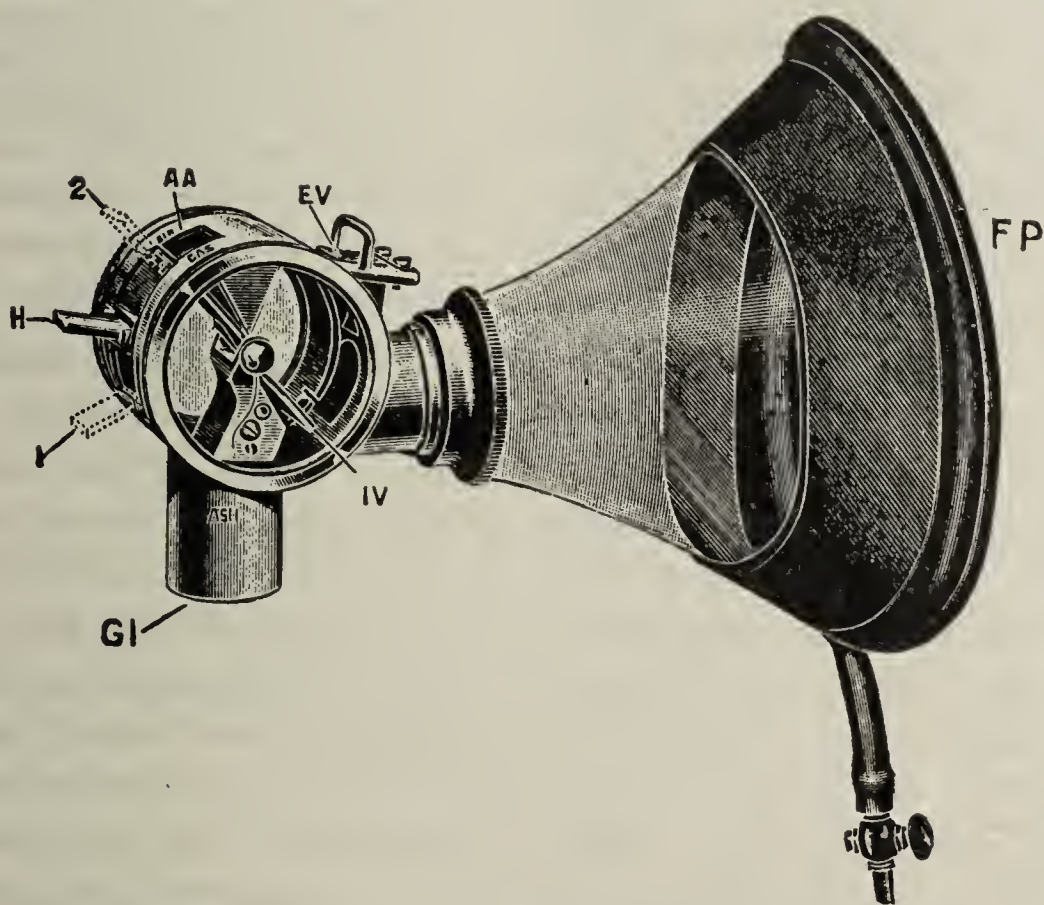


Fig. 2.—Three-way stopcock. (Mr. F. Coleman's principle.) *FP*, face-piece; *EV*, expiratory valve (rubber); *IV*, inspiratory valve (aluminium); *AA* air aperture; *GI*, gas inlet tube to which Cattlin's bag is attached; *H*, handle set for nitrous oxide; 1, handle set for air; 2, handle set for rebreathing into bag.

pire it into the rubber gas-bag. Some face-pieces are made of transparent celluloid, thus allowing a view of the patient's mouth during the administration, and are provided with a hollow rubber rim which can be inflated to any desirable degree with air, close adaptation to the face being thereby facilitated. The valves admitting gas from the cylinders into the gas-bag are operated either with the foot or by hand. The cylinders are made in three standard sizes, yielding respectively, 100, 250, and 450 gallons of

nitrous oxide. Only one cylinder is drawn upon at a time, the second being reserved for when the first has been emptied; the first should then be at once replaced. **Administration.**—The anesthetizer should begin by testing the apparatus to make certain that the valves are in good working order and that the gas passes into the bag freely. Upon application of the face-piece to the patient, no especial directions about his breathing need be given unless the respiration be hurried and nervous at the time, when he should be instructed to breathe steadily in and out, slowly and without straining. Excessively deep breathing is apt to result in a too rapid anesthesia and a correspondingly quick recovery from the gas. The face-piece should be held against the face with the thumb and forefinger just tightly enough to prevent leakage of air under the cushion; the remaining fingers may

be advantageously used in supporting the patient's jaw, which tends to drop as anesthesia supervenes. When the valves are seen to be working properly and the patient has become accustomed to the face-piece, nitrous oxide should be admitted, rapidly enough to keep the gas-bag two-thirds full, but with avoidance of sudden gushes of gas from the cylinder, lest freezing of it and occlusion of the exit take place. The gas should preferably be admitted into the face-piece at the beginning of an inspiratory movement. Where, after a period, duskiness is noted, twitching about the eyes is seen, or jactitation of the extremities takes place, the gas should be turned off and air allowed to enter for one complete inspiration.

The best indications that unconsciousness has been produced are, according to Buxton, an automatic type of breathing similar to that during sleep, though more frequent; a dusky, livid color of the face, and a distant, expressionless look in the eyes. There may be oscillation or fixation of the eyeballs, quivering of the eyelids, dilatation of the pupils, slight stertor of breathing, and jerky movements of the limbs. Flaccidity of the arms, with descent of an arm previously held up voluntarily by the patient, is also a useful sign of anesthesia. The face-piece should then be removed and the operation proceeded with.

Administration of nitrous oxide-ether sequence by the open method described. Children object to any formidable-looking face-piece, or one that it is necessary to apply firmly to the face. The author therefore uses a Gwathmey mask, covered with 16 thicknesses of surgical gauze. A yoke

is attached to a cylinder of nitrous oxide, and this is connected with the mask by a piece of rubber hose about six feet long. It is best to run the gas through a warmer.

The author reassures the patient and explains what he is to expect, showing the mask and allowing a puff of gas to flow, so that it is heard. He then applies the mask to the face and turns on the gas. When the patient is unconscious or nearly so, as determined by the breathing, he adds ether by the drop method, gradually increasing it and decreasing the flow of nitrous oxide at the same time. As soon as the patient is fairly under ether the nitrous oxide is stopped and the ether continued by the drop method. A. M. Caine (N. O. Med. and Surg. Jour., Dec., 1911).

Returning consciousness is indicated by a reappearance of the normal color of the face, loss of the livid hue of the lips, a return of expression to or normal movements of the eyes, movements of the body or a limb, crying out (though the patient be still actually unconscious), and perhaps a noticeable contraction of the pupils. Unless the face-piece is still in position, operative work should then be discontinued, otherwise nightmare sensations and severe struggling may ensue.

Deviations from the natural course of nitrous oxide anesthesia, sometimes requiring corresponding modifications in management, may be noted in various types of individuals. Thus, in strong, muscular persons and in alcoholics a tendency to struggling and fighting is not infrequently manifested. In these patients a **too free access of air during the beginning of the induction period**, and also a **too strict exclusion of air in the later portion of the period**, are to be avoided. Before marked lividity or

jactitation occurs, air should be admitted and the depth of inspiration be increased by lifting the lower jaw upward and forward (Buxton). Care should be taken that the face-piece fits closely over the face in these cases. In anemic, feeble, and neurasthenic patients, both rapid anesthetization and rapid return to consciousness or perception of pain are characteristic. Here undue air exclusion is prejudicial, slow induction with free admission of air (or preferably oxygen) being advisable; the gas should be diluted more and more until just before the face-piece is taken off, when a final supply of pure gas may with advantage be given. Where breathing is shallow in these cases, pressure upon the jaw or thorax may be advisable to excite deeper inspiration. In children jactitation soon occurs unless air or oxygen is admitted with the nitrous oxide. Contraction of the bladder and vomiting should be guarded against in them by previous urination and abstention from food for three hours before the operation.

Among the possible minor complications of nitrous oxide anesthesia are retching or vomiting, due to swallowing of blood and mucus, the fixing of the mouth open with a dental prop, or idiosyncrasy. In the latter case, the retching occurring early, resort to another anesthetic may be necessary. Nervous individuals at times hold the breath—a condition that may be overcome either with reassuring words or by pushing the lower jaw forward rhythmically. "Gagging," generally occurring in smokers with irritable pharyngeal walls, may be remedied by pushing the nitrous oxide or, if previously

known to be likely, prevented by spraying of the throat with a 2 per cent. solution of cocaine.

UNTOWARD EFFECTS.—A. During Anesthesia.—Cyanosis, usually encountered among heavy, plethoric persons, particularly if past middle age, is generally remedied by admission of air or oxygen; if not, the nitrous oxide anesthesia should be abandoned.

Pallor during induction may be the forerunner of syncope, and demands early treatment, *e.g.*, lowering of the patient's head. Syncope, a rare complication of nitrous oxide anesthesia, may occur either before anesthesia is complete or when the operation is begun, and takes place chiefly in the anemic, the feeble, and those in whom breathing is, for any reason, hindered. Fright and shock may be factors in its production. Tendency to faintness under nitrous oxide should be antagonized with such measures as the use of smelling salts, rubbing the hands, and slapping the face and chest with towels moistened with cold water. Buxton, in minor degrees of faintness, recommends bending the patient's body down so that his face is placed between his knees, as well as oxygen inhalations. In more pronounced cases he has found partial or total inversion of the patient very useful.

Cessation of breathing in profound nitrous oxide narcosis in young children may be remedied by compression of the lower part of the chest between the hands. The same procedure is employed by Buxton in adults where interruption of breathing lasts longer than five or six seconds.

In asphyxia due to foreign bodies such as vomitus or teeth, mechanical

removal of these bodies, with tracheotomy as a last resort in case the maneuvers fail, is indicated.

Laryngeal spasm, a rare complication, can usually be overcome by rhythmic traction upon the tongue (Buxton).

Epistaxis, hematemesis, and hemoptysis in phthisical cases, are other possible accompaniments of nitrous oxide anesthesia.

Death under nitrous oxide has been known to occur in occasional instances, though it is doubtful if the action of the gas *per se* was the cause of exitus in any of the cases reported. In a fatal case observed by Olow necropsy showed syphilitic changes in the aorta, secondary hypertrophy of the heart, coronary sclerosis, and degeneration of the heart muscle. He attributes the asphyxia to narrowing of the oropharyngeal aperture, giving rise to impeded respiration, especially through the mouth, which, as Thewky has pointed out, occurs mostly in cases with large and flabby tongues. In similar cases, prompt tracheotomy might save life.

Artificial respiration is to be borne in mind as the remedial procedure *par excellence* where a serious asphyxial state or respiratory depression develops in nitrous oxide narcosis.

B. After Anesthesia.—After-effects from nitrous oxide rarely occur. Vomiting after oral operations is generally not due to the anesthetic, but to swallowing of blood. In the early months of pregnancy, as well as in children, vomiting follows with somewhat unusual frequency.

A feeling of weakness or sleepiness complained of by the patient after the anesthesia can be overcome by deep

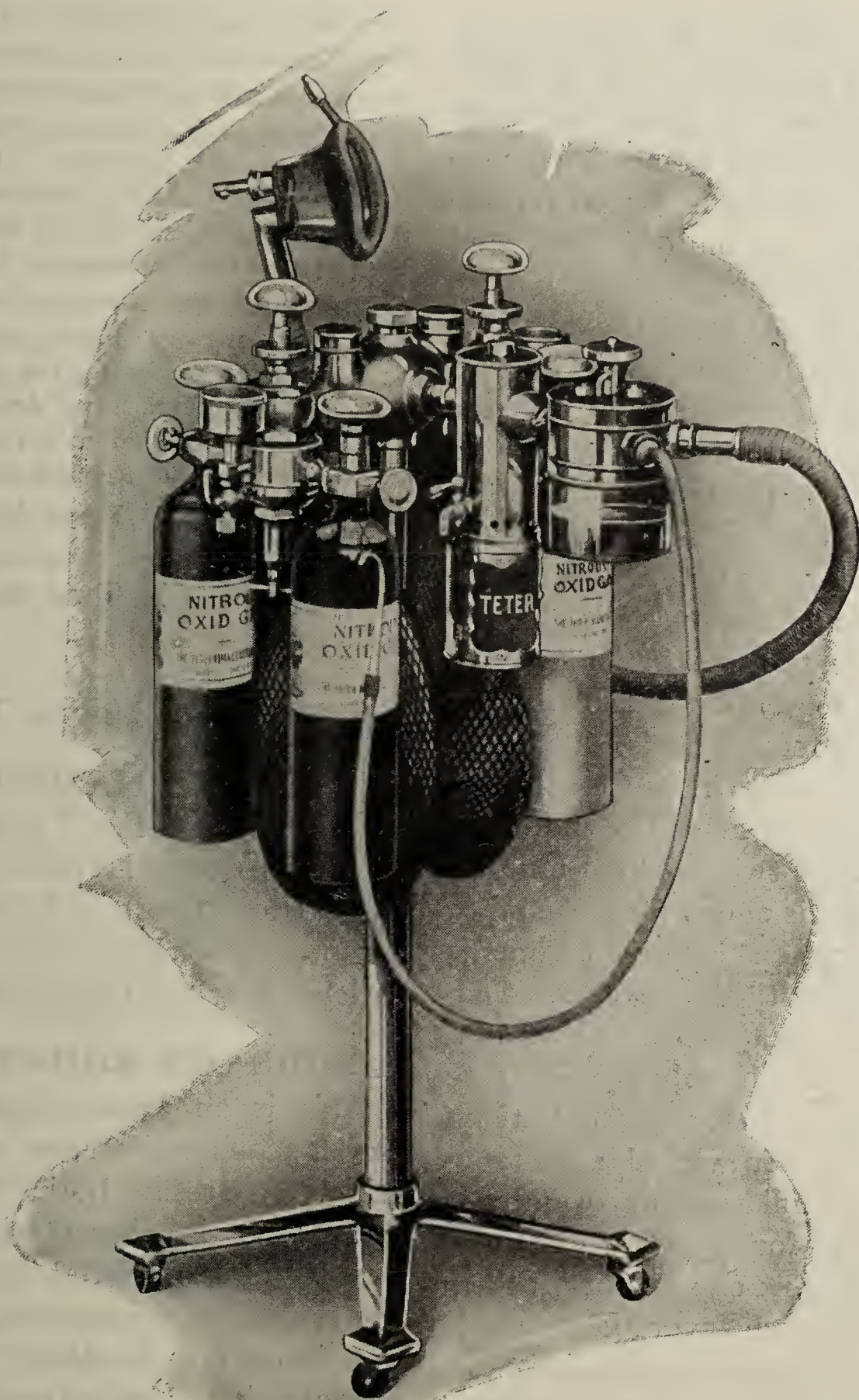
inspirations or lowering of the head. Persons who fail to recover strength and comfort promptly upon cessation of the anesthesia should be required to stay recumbent on a lounge for half an hour.

Severe headache, nausea, malaise, slight vertigo, transient insomnia, anosmia, and albuminuria are infrequent sequelæ.

Apoplexy and hemiplegia have been known to occur as a result of nitrous oxide anesthesia, presumably owing to the rise of pressure produced by an asphyxial state of the blood. The frequency of such cases has, however, been often exaggerated.

NITROUS OXIDE-OXYGEN ANESTHESIA.—Although the administration of nitrous oxide can be somewhat prolonged by allowing the patient occasionally to breathe air, prolonged anesthesia without cyanosis or jactitation cannot well be obtained without the use of oxygen. Originally presented by Paul Bert, this method was largely developed by Sir Frederic Hewitt, and more recently further perfected by Teter and adapted for major surgery. It has been claimed that it may be used in diabetes, regardless of the character or length of operation; that it is not irritating, thus preventing accumulation of mucus in the air passages, and not depressing on the pulse or respiration; also that it tends to prevent shock, and causes no fear and thus rarely provokes struggling or outcry. It is contraindicated in cardiovascular degeneration, defective lung ventilation, and old people showing degenerative processes.

According to Teter the ideal patients for this method are the very weak, the debilitated. It is not ideal for



Teter regulated pressure apparatus with vapor warmer and all attachments.

major surgery when a large amount of anesthetic is required. But even here it is useful as an adjunct to complete local anesthesia.

The forms of apparatus now in general use comprise a stand bearing one or more cylinders each of nitrous oxide and of oxygen gas-bags, a mixing chamber, a tube, and a face-

piece. Teter's apparatus also includes pressure regulators, a vapor warmer, and an ether attachment permitting of the addition of from 1 to 20 per cent. of ether vapor to the gas where there is persistent rigidity. About 100 gallons of nitrous oxide and 20 gallons of oxygen per hour are used with the Teter apparatus,

In some clinics an injection of atropine and morphine, with or without scopolamine, is given one hour and a half or more before the anesthesia. The patient is placed recumbent, dorsally or on one side, and often a wooden plug, with string attached, placed between the teeth to keep the mouth open, especially if there is nasal obstruction or the mouth is being operated upon. In beginning the induction no oxygen, or only 2 per cent., is mixed with the nitrous oxide. Later, a larger admixture, usually not exceeding 10 per cent., is made, the anesthetist striving, by constant regulation of the mixture, to steer between cyanosis, due to insufficiency of oxygen, and excitation, due to an excess of it. The induction period occupies two or three minutes where oxygen is added from the start. The necessity for oxygen augments progressively with the duration of administration, but the absolute amount used varies considerably according to the age and condition of the patient.

Although Teter was able to tabulate 9882 administrations of nitrous oxide-oxygen for general and oral surgery with but one fatality, others have not had such favorable results.

Nitrous oxide is not nearly so safe as chloroform, always considered dangerous. The writer quotes 14 deaths known to have occurred in Columbus alone. Gwathmey reported 3 fatal cases in 2500. In all reported cases death occurred suddenly before any marked change was noticed, and all efforts at resuscitation proved vain.

Titus reported 26 nitrous oxide-oxygen fatalities; Miller, 18 collected from literature; Roosing, 13. Gwathmey referred to 40 unreported deaths; Connell believes that the reported and unreported deaths far exceed those from ether. Luke had 1 death per

200 administrations. At the Mayo Clinic no fatalities occurred in 1400 cases given nitrous oxide oxygen preliminary to ether but they later abandoned the practice. Ochsner compared 100 cases of nitrous oxide oxygen anesthesia with a similar number of ether anesthetics by the drop method, but observed no difference other than a little more bronchial irritation following the use of nitrous oxide oxygen, thus demolishing one of its strong claims over ether. Baldwin (Medical Record, July 29, 1916).

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NOMA. See MOUTH, DISEASES OF.

NOSE AND NASOPHARYNX, DISEASES OF.—Three diseases—ACUTE RHINITIS, HYPERESTHETIC RHINITIS (HAY FEVER), and ADENOID VEGETATIONS.—have been treated as separate articles, to which the reader is referred.

CROUPOUS RHINITIS.

This is an acute inflammation of the mucous membrane of the nose which occurs in both children and adults. It is characterized by the deposit of a fibrinous exudate upon the surface of the mucosa, which does not show any tendency to undergo organization. Aside from nasal diphtheria, which is considered under the general subject of diphtheria, we occasionally meet with cases of acute rhinitis accompanied by the formation of a false membrane. This, however, is a comparatively rare condition. It must always be differentiated from *nasal diphtheria* and the patient should be isolated until the diagnosis is positively established by bacteriological examination. In most instances the disease is of bacterial

origin, but is not due to any specific micro-organism, the various forms of staphylococci and the *Streptococcus pyogenes* being most commonly found. It is thought by some that the gouty and rheumatic diatheses are influential in its production. It sometimes follows the use of caustics and the galvanocautery in the nose. The course of the disease is short, usually lasting but a few days.

TREATMENT.—The local treatment consists in the removal of the pseudomembrane by the application of hydrogen dioxide on pledgets of cotton, or used as a spray or douche by diluting with 3 parts of warm water, to be followed by an alkaline antiseptic solution, after which the membrane is dried and a 20 per cent. solution of argyrol applied by means of a cotton carrier. A more powerful germicidal effect may be obtained by the application in the same manner of Löffler's solution, which has the following formula:—

℞ *Toluolis* 36 parts.
Alcoholis absoluti 60 parts.
Liquoris ferri chloridi 4 parts.

As this solution produces considerable pain, it should be preceded by a 2 per cent. solution of cocaine.

Internally, divided doses of calomel should be administered and followed by a saline. The tincture of ferric chloride in 10- to 20- drop doses is also indicated.

PURULENT RHINITIS.

This is an inflammation of the nasal mucous membrane in which the discharge is purulent from the beginning. It is exceedingly rare in adults, but occurs more frequently in young children. The predominating symptom is a profuse, thick, puru-

lent discharge. Nasal obstruction occurs from the accumulation of the discharge in the nasal cavities. Emaciation frequently results from the inability of the child to nurse properly.

Bosworth maintains that purulent rhinitis occurs as a primary disease in childhood and, when neglected, results in atrophic rhinitis in adult life. Some authorities claim that it never occurs as a primary disease, but is merely a symptom, usually of suppuration of the accessory sinuses. There is nothing to prevent the nasal mucosa, when infected, from becoming a pus-producing membrane, just as any other mucous membrane becomes under similar circumstances. It is probable that a large proportion of the cases occurring in young children are due to infection of the nose from the vaginal secretions of the mother during birth, although the condition is rarely seen in its incipency. When occurring in adults, it is believed by some to be due primarily to the acute exanthemata. D. Braden Kyle describes 2 cases in which the infection was carried to the nose by the fingers of the patient; in 1 case from the urethra, in the other from the ear.

In order to exclude foreign bodies, suppuration of the accessory cavities, and tuberculous or syphilitic disease as a cause of the purulent discharge, a thorough examination of the anterior nasal cavities should be made.

TREATMENT.—The nose should be kept scrupulously clean by spraying or douching with normal saline solution, or a saturated solution of boric acid. In young children an ordinary medicine dropper or a soft-rubber syringe may be used. In

older patients, a solution of **bichloride of mercury** in the strength of 1:8000 may be employed. The solutions should always be used warm. The nasal cavities should be thoroughly cleansed once a day with **hydrogen dioxide** applied with a cotton-wrapped applicator, or as a spray diluted with 3 parts of water, after which the membrane is carefully dried and an astringent application, such as **nitrate of silver**, 30 grains to the ounce, or **argyrol**, 20 per cent., made over the entire membrane. The internal administration of the **syrup of the iodide of iron** and **codliver oil** are usually indicated.

SIMPLE CHRONIC RHINITIS.

—Simple chronic nasal catarrh; chronic coryza; chronic nasal catarrh; chronic rhinitis.

Simple chronic rhinitis is a chronic catarrhal inflammation of the nasal mucous membrane, resulting from prolonged irritation of the mucosa or recurring attacks of acute rhinitis. It is characterized by relaxation, swelling, and boggy condition of the membrane, with an alteration in both the character and amount of the secretion.

SYMPTOMS.—The principal symptoms of which the patient complains are nasal obstruction and an increase in the amount of secretion from the nose, and frequently the nasopharynx as well. In the early stages the discharge is profuse and watery in character, while later, as the condition progresses, it becomes less profuse, thick and tenacious in consistency, mucopurulent in character, with a tendency to the formation of crusts. The nasal obstruction is usually intermittent and may be partial or complete, frequently alternating between the two sides.

It is generally more marked at night and the effect of gravitation is shown by the obstruction of the more dependent side during sleep. As a result of the nasal obstruction there is alteration in the voice, due to the absence of normal nasal resonance. Distressing symptoms, such as frontal headache, pain over the bridge of the nose, eyes and cheeks, are not likely to be marked unless the accessory sinuses become involved, but we frequently hear patients complain of a feeling of dullness, dizziness, loss of memory, partial loss of the sense of smell, errors of vision, closure of the Eustachian tubes, impaired hearing, and, if nasal obstruction is not relieved, the symptoms of pharyngeal and laryngeal involvement appear.

The patient suffering from simple chronic rhinitis is predisposed to frequent attacks of the acute form. Sneezing is often complained of, especially during the acute exacerbations, and in many cases the alæ and tip of the nose are congested and may become quite red. A sensation of itching or tickling in the nose is frequently present, due to the dryness and accumulated secretion, which causes the patient to constantly pick the nose, resulting in abrasion and ulceration of the septal mucosa and, even, perforation. In some patients, especially those of advanced age, the only symptom present is a profuse watery discharge, which at times is so abundant as to produce a great deal of annoyance.

Inspection of the anterior and posterior nares will show a relaxed, swollen, and boggy condition of the mucous membrane, especially over the lower portion of the septum and the inferior and middle turbinates.

More or less discharge will be seen upon the surface of the membrane. The color of the mucosa varies according to the general condition of the patient. While the membrane is usually redder than normal, yet there are many cases in which there is no increase in color; especially is this true in children, in whom there is often a great amount of discharge. In anemic individuals, although boggy of the tissue is apparent, the color is not heightened above the normal, and very frequently it is quite pale. On the other hand, in plethoric patients, the membrane is very much redder than normal and may even be livid. In the debilitated and those of advanced age, the membrane is usually pale and sometimes blanched.

DIAGNOSIS.—No difficulty should be experienced in making a diagnosis of simple chronic rhinitis. It is based upon the clinical history, the nature of the discharge, and the character of the mucous membrane, as determined by inspection and palpation.

ETIOLOGY.—Simple chronic rhinitis results from a prolongation of an acute attack or from frequently repeated attacks of acute rhinitis. The predisposing and exciting causes are identical with those of acute rhinitis. Frequent exposure to cold and draughts, a changeable and humid atmosphere, insufficient food, improper clothing, faulty ventilation, deficiency of sunlight and fresh air, and other unhygienic conditions are among the important predisposing factors. Congenital asymmetry of the nasal cavities, spurs and deflections of the nasal septum, adenoid vegetations in the nasopharynx, traumatism, foreign bodies and nasal polypi are local causes of the dis-

ease. The various diatheses play an important part as etiological factors, gouty, rheumatic, diabetic and strumous individuals being peculiarly susceptible to simple chronic rhinitis. Gastrointestinal derangements, chronic renal, hepatic, or cardiac lesions, affecting the nasal mucosa by irritation and vascular changes, may be responsible for the disease. It is frequently a sequel to the acute rhinitis of the newborn, and is especially liable to follow the acute form occurring in the infectious diseases. Certain occupations favor its development by exposing the mucous membrane more or less constantly to the irritating effects of vapors, such as ammonia, chlorine, bromine, and iodine, or to an atmosphere containing fine particles of dust, as in the case of millers, weavers, metal-workers, coal-miners, wood-carvers, stone-cutters, etc. Such substances as arsenous acid, potassium dichromate, mercury, the fumes generated by muriatic acid on lead solder, and the emanations of caustic acids, when inhaled for a long period of time, produce simple chronic rhinitis.

PATHOLOGY.—As a result of the constant irritation of the mucous membrane or the prolongation or frequent repetition of an acute inflammation, the changes in the vascular mechanism which accompany the acute condition become more or less permanent. The repeated or constant distention to which the blood-vessels have been subjected results in a loss of their normal contractility and they remain distended. The vessel walls become softened and there is an increased permeability with a continual escape of the elements of the blood, more particularly the white

corpuscles, which penetrate the connective tissue, where they proliferate, and, together with the proliferation of the fixed connective-tissue cells, produce new inflammatory tissue, thus inducing thickening and induration of the membrane. To a certain extent the venus plexuses of the turbinates take part in the inflammatory process and become enlarged from overdistention.

PROGNOSIS.—If allowed to go untreated, simple chronic rhinitis may remain stationary, or result in hyperplastic or atrophic changes in the mucosa. It may give rise to the formation of polypi and is often the origin of a catarrhal inflammation of the Eustachian tubes. With the removal of the cause and the institution of proper remedial measures the prognosis is favorable. When the affection is due to repeated attacks of acute rhinitis, recurrences are frequent.

TREATMENT.—The treatment of simple chronic rhinitis is both constitutional and local, and consists in the discovery and **elimination of the underlying cause** and the institution of proper local measures for the **relief of the pathological alteration in the nasal mucous membrane**. Before resorting to local or operative measures, the general physical condition of the patient must be carefully investigated. The presence of gout, rheumatism, lithemia, diabetes, cardiac, renal or hepatic lesions, or syphilis, necessitates proper **internal, dietetic, and hygienic treatment**.

If the affection is due to some external irritant the patient must be removed from such exposure. **Spurs and deflections** of the nasal septum, which produce obstruction to respira-

tion and drainage, or exert pressure upon the turbinates, should be regarded as etiological factors and **corrected by suitable operative treatment**. Likewise, the presence of **enlarged, deformed or cystic turbinated bones** may also **require operative treatment**. Before removing any portion of the turbinate, however, a careful examination by inspection and probe palpation must be made to determine that the enlargement is actually in the bony structure and not in the mucous membrane covering it. In all surgery of the nasal cavities our first consideration should be the conservation of the mucous membrane and the sacrifice of the turbinates indiscriminately cannot be too strongly condemned. If the turbinate bone is so deformed or diseased as to justify removal, this should be done by first dissecting the mucous membrane free from the bone and then removing as much of the bone as may be necessary. In those cases in which the inferior turbinate projects horizontally across the nasal cavity, producing obstruction and pressure upon the septum, I have obtained very satisfactory results by making a straight saw cut beneath the turbinate bone at its base, then fracturing the bone and forcing it back toward the outer nasal wall.

The local treatment of simple chronic rhinitis consists of measures directed toward the removal of the discharge, the absorption of the inflammatory products and the restoration of vascular tone to the membrane. Proper **cleansing of the nasal cavities** is of the utmost importance and is best accomplished by the use of **normal salt solution**, made by dissolving a teaspoonful of common salt

in a pint (500 c.c.) of warm water, or of an alkaline, antiseptic wash, such as **Dobell's** or **Seiler's** solution, may be used. The cleansing solution should be used twice a day, by means of an atomizer or nasal douche, and the patient is to carry out this treatment at home. Following the cleansing he is instructed to instill a few drops of an oily solution, such as the following:—

℞ *Camphoræ*,
Mentholisāā gr. ij (0.13 Gm.).
Olei eucalypti,
Olei pini pumilionis āāgtt. ij (0.12 c.c.).
Olei cinnamomi gtt. iij (0.18 c.c.).
Petrolati liquidi f℥j (30 c.c.).

Misce.

This is slightly antiseptic, stimulating and protective to the mucous membrane.

There is a great tendency upon the part of patients suffering from nasal affections to use the atomizer or nasal douche to excess. Constant washing of the nasal cavities, especially with strong solutions, produces irritation which often keeps up the very condition it is desired to relieve. While it is of the greatest importance to keep the nasal passage free from discharge, yet in many cases of simple chronic rhinitis, particularly of the moist type, it is not only unnecessary, but often even harmful, to use the nasal douche continuously twice a day for an indefinite period.

For the purpose of promoting absorption of the inflammatory products and restoring vascular tone, there should be applied to the anterior and posterior nares, after carefully cleansing and drying the membrane, stimulating or astringent solutions, depending upon the requirements of the individual case. Of the various

medicinal agents recommended for this purpose, equal parts of **compound tincture of benzoin** and **boroglycerin glycerite**, or a 25 per cent. aqueous solution of **ichthyol**, applied by means of a cotton-wrapped applicator, give most excellent results in many cases.

The **phenolated iodotannin glycerite** is highly recommended by Sajous, and is prepared as follows:—

℞ *Iodi* ℥ss (2 Gm.).
Acidi tannici ℥ss (15 Gm.).
Aquæ Oss (250 c.c.).

Mix, filter and evaporate to ℥ij (62 c.c.), and add

Phenolis gr. ij (0.13 Gm.).
Glycerini f℥iv (125 c.c.).

This preparation forms a clear solution, and by virtue of its oily consistency remains in contact with the membrane for a considerable period of time. In order to obtain the best effects it should be applied several times daily, after thorough cleansing of the parts. This may be done by the patient, who should be taught to make the applications by means of a feather, which is dipped in the solution and introduced into the nasal cavity and so manipulated as to bathe the mucous membrane thoroughly. In most cases the end of the feather can be pushed back into the posterior nares so that they may participate in the treatment. The applications should be made upon rising, twice during the day, and again on retiring, thus maintaining that continuous action, an essential factor in the treatment.

In some cases it may be necessary to resort to more astringent applications, such as a solution of **silver nitrate**, 20 to 40 grains (1.3 to 2.6 Gm.) to the ounce (30 c.c.), **tannic acid glycerite**, **zinc sulphocarbolate**,

2 per cent., or **zinc chloride**, 2 per cent., all of which produce their therapeutic action by contracting the blood-vessels and promoting absorption of the inflammatory products. At first these applications should be made every other day, and less frequently later, as the condition improves. At times the beneficial effects seem to be enhanced by alternating the different remedies. As an adjunct, the internal administration of **strychnine sulphate**, in $\frac{1}{30}$ grain (0.002 Gm.) doses, three times a day, is a valuable remedy for toning up the vascular system of the nasal mucosa.

When the changes in the mucous membrane have become so permanent that it fails to respond to the above treatment, more energetic measures must be resorted to. The application of chemical **caustics** or **escharotics** to the surface of the mucosa is recommended by many for the purpose of reducing the turbinal tissue, and of these agents **chromic acid** is the most valuable. The mucosa is first anesthetized by the application of a 4 per cent. solution of **cocaine**, after which the **chromic acid**, fused upon the end of a probe, is drawn along the most prominent portion of the turbinate. This results in a linear eschar, which, upon healing, permanently binds down the redundant tissue. A method of employing escharotics which obviates the surface scar is **submucous cauterization**, introduced by Norval H. Pierce. The mucous membrane is punctured near the anterior free border of the turbinate and a channel made with a blunt probe beneath the membrane, into which a fused bead of chromic acid is introduced.

Goldstein has improved this method by devising an instrument which conceals the bead of chromic acid in a cannula during introduction, after which the bead of acid is thrust from the end of the cannula and the instrument withdrawn. Immediately following the application of the chromic acid, the nasal cavity should be sprayed with an alkaline solution to prevent its spreading.

The **galvanocautery** is of value in properly selected cases, but, while still recommended by many, is used much less frequently than formerly. The mucous membrane should first be cocainized, then the electrode is introduced into the nasal cavity and the current turned on until a bright cherry-red heat is obtained, when it is brought in contact with the tissue and drawn from behind forward so that a linear cauterization results. The entire turbinate should not be cauterized at one time, but in three or four sittings at intervals of one week, thus limiting the amount of inflammatory reaction. The galvanocautery may also be employed submucously without producing much destruction of the surface mucosa. For this purpose long, pointed platinum electrodes are employed, which are passed deeply into the tissue and the cauterization is thus chiefly limited to the submucosa. Following the use of the galvanocautery the nares should be kept clean by means of **normal salt solution** or one of the **alkaline antiseptic solutions** previously mentioned.

The disadvantages of the application of escharotics and the galvanocautery to the surface of the mucous membrane are that they produce considerable slough, which may come

away and cause severe hemorrhage; that there is more or less destruction of the mucous membrane with resulting scar-formation, and the danger of infection and the formation of adhesions between the turbinate and the septum.

The employment of **systematic pressure** by means of **hard-rubber or metallic tubes or splints** is very effective in some cases. The size of the splint is selected according to the individual case, although it is preferable to begin with the smallest caliber and gradually increase the size. At first they should be introduced twice daily and permitted to remain for the space of a few minutes only, but after the treatment has been followed sufficiently long this may be increased to a much greater period. As great discomfort is frequently produced by this method it is seldom employed.

Massage is highly recommended by some for the purpose of stimulating the mucous membrane.

Some authorities recommend making **deep incisions into the turbinal tissues in the long axis of the bone**, thereby producing great depletion and resulting in sufficient cicatricial tissue to permanently reduce the enlarged condition of the turbinate.

A method which I have found most satisfactory in these cases is **submucous scarification**. The mucous membrane is first anesthetized by the application of a 4 per cent. solution of **cocaine**, after which a small, sharp-pointed knife, similar to that employed for incising the tympanic membrane, is introduced at the anterior free border of the turbinate and carried back beneath the membrane as far as necessary. The

knife is then turned in all directions and the submucous tissue thoroughly scarified. The inflammatory reaction which is thus induced results in permanent contraction of the membrane and has the advantage of not producing any surface scar.

INTUMESCENT RHINITIS.

This is not a distinct disease entity, but simply a different stage of chronic rhinitis, in which there is great turgescence of the mucous membrane covering the turbinates, more especially the inferior, due to the distention of the blood-vessels and an outpouring of exudate into the tissues.

SYMPTOMS.—The characteristic symptom is the sudden and transient swelling of the turbinal tissue, which produces marked obstruction of nasal respiration. The swelling may involve one or both sides, or may alternate between the two sides. There is also considerable secretion, which is sometimes thin and watery, but more frequently thick, tenacious, and mucopurulent.

Anterior rhinoscopy shows great tumefaction of the erectile tissue over the inferior turbinate. The mucous membrane appears moist and the color varies according to the general condition of the patient, but is usually red, smooth, and boggy; in anemic patients, however, it may be decidedly pale. Probe palpation produces a marked indentation, which immediately disappears when the pressure is removed. The application of a solution of cocaine or adrenalin chloride causes great contraction of the membrane, whereas in hyperplastic rhinitis it has little or no effect. Posterior rhinoscopy or the nasopharyngoscope will reveal

the same condition of the posterior end of the turbinates.

ETIOLOGY.—The causes are those of simple chronic rhinitis, although this form is more often associated with some systemic disease, especially gout or rheumatism, or it may be due to a cardiac, pulmonary, hepatic, or renal lesion, which affects the peripheral circulation and produces active or passive congestion of the nasal mucosa. This condition is frequently mistaken for hyperplastic rhinitis and treated as such.

TREATMENT.—The treatment is practically the same as that described for Simple Chronic Rhinitis. Special attention should be directed toward the discovery and correction of any underlying systemic disease. Where local measures fail to relieve the symptoms, I have obtained the best results by submucous scarification, as previously described, the objects here being to cause obliteration of the venous sinuses and to produce sufficient inflammatory reaction to induce permanent retraction of the mucous membrane.

HYPERPLASTIC RHINITIS.—Hypertrophic rhinitis; hypertrophic ozena; obstructive rhinitis; hypertrophy of the turbinated bones; hypertrophic nasal catarrh; chronic hypertrophic rhinitis.

This is a chronic inflammatory process of the nasal mucosa, and is characterized by a permanent increase of the connective-tissue elements, more especially over the turbinates, producing more or less nasal obstruction.

SYMPTOMS.—The chief symptoms of hyperplastic rhinitis are nasal obstruction and alteration in the secretion. The obstruction may

be either unilateral or bilateral, and depends upon the extent of the disease and the location of the turbinal enlargement; it may vary from slight obstruction to complete stenosis of the nasal cavity. The hyperplasia may be limited to the anterior or posterior end of the turbinate, or the entire surface may be involved. In individuals with very narrow nostrils the slightest degree of hyperplasia will produce marked nasal obstruction. In some instances there is an actual enlargement of the turbinated bone, but this is uncommon. There is an alteration in both the amount and character of the secretion; in most instances it is scanty, thick, and tenacious, especially if the condition has existed for any length of time, while in others it is quite profuse. The retained secretion may become infected by saprophytic bacteria, producing a very offensive odor. These symptoms are not characteristic of this affection, as they also occur in simple chronic and intumescent rhinitis, deformities of the septum, and, in fact, all conditions in which there is nasal obstruction. There is usually some deformity of the septum present, such as a spur, ridge, or deflection.

The appearance of the nasal mucosa varies according to the extent and location of the hyperplasia. If the anterior end of the turbinate is involved, the membrane may be red and smooth, or granular or lobulated in the early stages, while in well-advanced cases it often presents a pale, lobulated or pedunculated appearance, especially if the membrane is undergoing polypoid degeneration.

Hyperplasia occurring at the posterior end of the inferior turbinate

may partially or completely obstruct the choanæ, and even project to such an extent as to block the Eustachian orifice. Posterior rhinoscopy or the nasopharyngoscope will, in some instances, show a dark-red or purplish swelling, with an irregular surface, much resembling a raspberry or mulberry, which bleeds freely upon the slightest irritation; this is believed to be an early stage. In other cases the enlargement presents a rounded, smooth, whitish growth, which may be roughened or even lobulated, and is probably a later stage than the mulberry growth. When the body of the turbinate is involved it usually presents an appearance similar to that seen at the anterior end of the turbinate. The hyperplastic membrane at times presents the appearance of a fibrous polyp and may be mistaken for this condition. Nasal polyps may also be associated with this affection.

Owing to the nasal obstruction, mouth-breathing becomes more or less constant, especially at night, and the patient complains of dryness of the mouth and throat, which is a very distressing symptom. If the nasal obstruction continues for a long time, there is a resulting inflammatory condition of the nasopharyngeal and pharyngeal mucosa. There is hawking and clearing of the throat in an effort to remove the accumulated secretion in the nasopharynx. Cough may be present as a result of the irritation of the pharyngeal mucous membrane. As a result of the nasal obstruction there is alteration in the voice, due to the absence of normal nasal resonance. Headache and a sensation of fullness or pressure about the eyes and bridge of nose

and forehead are frequently complained of and the patient may suffer from aprosexia caused by the constant pressure in the nasal cavities due to hyperplasia. Sneezing is sometimes a prominent symptom and results from the contact of the turbinal membrane with that of the septum. In the later stages of the affection, the sense of smell may be impaired or totally lost.

DIAGNOSIS.—The diagnosis is very important, inasmuch as the condition present in simple chronic and intumescent rhinitis, as well as the engorgement resulting from plethora, local irritants, and the neuroses may present an appearance closely resembling that of hyperplastic rhinitis, yet the treatment is very radically different.

In the former conditions the mucous membrane can be restored to normal by proper treatment, while in true hyperplasia the changes are permanent, and the normal function cannot be restored, but sufficient tissue must be removed to obtain adequate breathing space.

The application of a solution of cocaine or adrenalin chloride produces rapid and marked contraction of the mucous membrane in *simple chronic* and *intumescent rhinitis*, as well as the other conditions accompanied by engorgement, while if the case be one of true hyperplasia there is only very slight contraction, due to the relief of the superficial engorgement. On probe palpation the hyperplastic turbinate shows only a slight indentation, which disappears very slowly, while in intumescent rhinitis marked pitting is produced and the membrane fills out immediately upon removing the probe.

ETIOLOGY.—Hyperplastic rhinitis always results from a pre-existing simple chronic or intumescent rhinitis and is due either to a prolongation or neglect of these conditions. The constant increase in the blood-supply to the erectile tissues of the turbinates which accompanies repeated attacks of acute rhinitis or prolonged simple chronic and intumescent rhinitis is certain to produce an increase in the connective-tissue elements of the submucosa and eventually result in hyperplasia of the mucous membrane. Deformities and enlargements of the turbinated bones and spurs and deflections of the septum, by interfering with nasal respiration and drainage, and by causing pressure upon the neighboring structures, are important etiological factors. The disease is especially liable to occur in individuals who suffer from gout, rheumatism, lithemia, diabetes, and anemia. Some who believe that hyperplastic rhinitis depends wholly upon intumescence, which occurs only in certain areas provided with erectile tissue, lay stress upon cardiac, pulmonary, hepatic, and renal affections, which disturb the peripheral circulation and so produce active or passive nasal congestion, as factors in causing this form of rhinitis.

PATHOLOGY.—In this form of rhinitis the principal structural alteration is a quite marked increase in the connective-tissue elements of the submucosa. This new-formed connective tissue is a true hyperplasia and does not undergo contraction. The blood-vessels also participate in the pathological alteration, their walls becoming thickened and infiltrated, and there is an increase in the number of capillaries, from which the

new-formed connective tissue derives its blood-supply.

PROGNOSIS.—Under proper local and surgical treatment the prognosis is favorable. As the hyperplastic changes are localized, with the removal of the excess of tissue and the restoration of free nasal breathing, the remaining portion of the nasal mucosa, which has not undergone permanent change, will usually be sufficient to perform the nasal functions.

TREATMENT.—While local and internal medication are of some benefit in this affection, they must be regarded as only palliative. If permanent relief is to be expected, some form of **surgical interference** must be resorted to, with the view of **removing the excess tissue and re-establishing free nasal respiration.**

Any **systemic condition** which may be present, such as gout, rheumatism, diabetes, etc., **should receive proper medicinal, dietetic, and hygienic treatment.** Locally, the employment of a **cleansing alkaline solution** for the purpose of keeping the nasal cavities free from discharge is indicated. If there is any **deformity of the septum**, such as spurs, crests, or deflections, these should be first **corrected** by suitable surgical measures before operating upon the turbinates.

When the hyperplastic tissue is not excessive, the use of **chromic acid**, fused on a probe, or the **galvano-cautery** will often give satisfactory results. In dealing with anterior or posterior enlargement of the turbinates the **cold-wire snare** is the ideal instrument for their removal. The best type of this instrument is either the Sajous or Jarvis. The nasal cavity is first cleansed and the membrane thoroughly anesthetized

by the application of a 4 per cent. solution of **cocaine**, applied on pledgets of cotton and allowed to remain for a few minutes, followed by the application of **adrenalin** solution in the same manner. Under good illumination the wire loop is introduced and passed over the growth and gradually tightened until it is removed. In the case of posterior hyperplasia the operation is facilitated by introducing the nasopharyngoscope through the opposite naris, so that the manipulations can be carried out under the eye of the operator. Bleeding is controlled by **adrenalin chloride** solution or **hydrogen dioxide** applied on pledgets of cotton. Occasionally it becomes necessary to pack the nasal cavity with gauze, but this should be avoided whenever possible. Following the operation the nose should be cleansed twice daily with **normal salt solution** or one of the **alkaline anti-septic solutions**.

When the body of the turbinate is enlarged, D. Braden Kyle recommends making a **V-shaped incision** through the most dependent portion of the turbinate **and removing the tissue** with scissors, after which the two margins unite, resulting in a linear scar. For the removal of hyperplasia of the inferior surface of the lower turbinate, the **serrated scissors** or the **Jackson turbinotome** is very satisfactory.

ATROPHIC RHINITIS.—Dry catarrh; fetid catarrh; ozena; atrophic catarrh; chronic atrophic rhinitis; chronic fetid rhinitis, atrophic nasal catarrh; dry nasal catarrh; fetid rhinitis; rhinitis sicca.

This is an atrophic condition of the nasal mucous membrane, and

often the underlying bony structure as well, accompanied by the formation of crusts and a very offensive odor.

SYMPTOMS.—The chief symptoms of atrophic rhinitis are alteration in the character of the nasal secretion, with the formation of crusts, and the fetid odor. The most characteristic symptom is this very disagreeable odor, which is indescribable, but once encountered is not likely to be forgotten. It is generally believed to be due to decomposition of the secretion by the action of saprophytic bacteria, but the actual cause is still undetermined. The patient may or may not be conscious of the odor, as the sense of smell is always impaired and may be completely destroyed. Inspection will reveal large, roomy nostrils, the pharyngeal wall often being visible through the anterior nares. The inferior turbinate is invariably small or may be entirely absent in well-advanced cases, while the anterior end of the middle turbinate may appear to be enlarged. The mucous membrane is thin, pale, and firmly attached to the underlying bone. On probe palpation, instead of the normal soft, cushion-like sensation, the probe encounters a hard, resistant surface, which does not indent. Ulceration of the mucosa may be present, especially on the anterior part of the cartilaginous septum, and is usually caused by constant picking of the nose, this occasionally results in perforation of the septum.

Unless recently cleansed, the mucosa will be seen covered with a thick, tenacious secretion, which is closely adherent to all the structures. The color of the secretion varies in different cases, according to the stage

and severity of the disease, the atmosphere breathed, and the bacteria present. The discharge is often so thick and extensive as to completely occlude the nostril, and I have frequently removed a complete cast of the nasal cavity. Under these conditions, notwithstanding that there is a wide-open nostril, the patient suffers from nasal obstruction, which, however, is relieved after the removal of the crusts. In the early stage little difficulty is usually experienced in expelling these crusts, but as the condition progresses they become more tenacious and adherent, greater effort being required for their removal. Epistaxis frequently occurs from the vigorous efforts to dislodge the crusts.

The nasopharynx is invariably involved and the crusts are most tenacious and the membrane extensively affected. Upon lifting up the soft palate the crusts may be readily seen. The pharynx also becomes affected in many cases, although the crusts do not, as a rule, adhere to the pharyngeal mucosa, but this appears dry and glazed. The dryness may extend to the larynx in well-advanced cases and produce hoarseness and a hacking cough.

Pain is usually absent, although the patient sometimes complains of a sensation of fullness over the bridge of the nose and dull headache. Mental hebetude and depression are sometimes present, and the patient may suffer from melancholia as a result of self-consciousness arising from the disgusting odor which makes him a social outcast.

DIAGNOSIS.—The diagnosis of atrophic rhinitis is usually not difficult; the characteristic odor, the tenacious secretion, with the formation of

crusts and the marked atrophy of the nasal mucous membrane and turbinate bones, reveal the nature of the disease. It must be differentiated from *syphilitic necrosis of the nose*, but in the latter disease the process is generally more localized and does not present the extensive atrophy of the nasal structures.

ETIOLOGY.—The cause of atrophic rhinitis is still a disputed question, and while many theories have been advanced none have been definitely proven. The one most generally accepted is that the disease is the terminal stage of hyperplastic rhinitis, the atrophic process being brought about by the pressure produced by the new-formed connective tissue, which decreases the blood-supply and interferes with the function of the glandular structure and ultimately leads to atrophy.

On the other hand, an atrophic process occurs which is not due to any local obstruction, but to interference in the systemic circulation, as a result of a lesion of the heart, kidney, liver, or lung, by which the blood is dammed back on the mucous-membrane surface, the pressure thereby produced causing an atrophy of the connective tissue and glandular elements. This is a cyanotic congestion and pressure atrophy, as seen in red atrophy of the liver (D. Braden Kyle).

Heredity is believed by many to be an important etiological factor, inasmuch as the disease develops at a very early age and may occur in several members of the same family and, even, extend through two or more generations. This supposed hereditary influence is probably an inherited malformation of the bony structures

of the nose, which predisposes the patient to nasal inflammation. The disease is frequently seen in individuals who have certain abnormalities in the shape of the skull, as well as malformations in the superior maxillary, palate, and nasal bones, and in whom there is a broad, flat conformation of the face, with very large and roomy nasal cavities and small turbinated bones; and, while some authorities regard these changes as part of the atrophic involution, others consider them as antedating the disease and contributing to its production. The fact that the nasal cavities in atrophic rhinitis are lined with squamous epithelium in place of the columnar ciliated variety is believed by some to influence the development of the disease. The investigations of Meissner appear to prove that the flat, depressed nose of atrophic rhinitis is a contributory cause and not a result of the disease, and that the epithelial metaplasia, by which pavement epithelium appears in place of the columnar variety, is a primary condition and not the result of the local disease.

Bosworth maintains that the disease is always secondary to a purulent rhinitis in childhood.

Since the disease is frequently associated with suppuration in one or more of the accessory nasal cavities, Gruenwald advanced the theory that diseases of the accessory sinuses are the primary cause. However, there unquestionably occur many cases of atrophic rhinitis in which there is not the slightest suggestion of accessory sinus disease. On the other hand, cases of accessory sinus suppuration occur in which, notwithstanding the fact that the nasal mucous membrane

has been bathed in pus for a long time, there is no evidence of atrophic rhinitis. When the two conditions coexist, the accessory sinus involvement may be either primary or secondary.

Various micro-organisms have been isolated from the secretion by different observers, and by them assumed to be the cause of the disease, yet in spite of much recent literature upon the subject the etiological importance of bacteria has not been accepted as preponderating in the causation of atrophic rhinitis.

I think it can be safely said that there is no one etiological factor which can be assigned as the cause of atrophic rhinitis in every case, but that there are many conditions which contribute to the production of atrophic changes in the nasal mucous membrane.

PATHOLOGY.—The pathological alteration in the mucous membrane consists in a desquamation of the normal columnar ciliated epithelial cells, which are replaced by squamous epithelium. There is a marked decrease in the connective tissue of the submucosa, with obliteration of the blood-vessels, together with a diminution or complete destruction of the glandular elements. The venous sinuses are usually entirely obliterated. As the process progresses the mucous membrane becomes more or less fibrous and the underlying bony structures, especially the inferior and middle turbinates, undergo atrophic or degenerative changes.

PROGNOSIS.—The prognosis as regards a complete cure is unfavorable, as it is obvious that where the mucous membrane has been destroyed it can never be restored. If the case

is seen early, before extensive pathological alterations have taken place, it would seem that almost complete recovery might be expected, but the majority of these patients do not apply for treatment until the condition is well advanced. As to the relief of the disagreeable symptoms, much can be done by careful and persistent treatment.

TREATMENT.—Careful attention should be directed to the general condition of the patient, especially with the object of **eliminating any hereditary influence or systemic condition** which may have an **etiological bearing on the disease**. Internally, the administration of **potassium iodide** is of great value, and the patient should receive such other **constitutional treatment** as may be indicated in the individual case. Special attention should be given to general **hygiene**. **Irregularities or obstruction of the nasal cavities should be corrected by proper surgical measures**. Should there be any disease of the accessory sinuses this should be treated according to the methods described under DISEASES OF THE ACCESSORY SINUSES.

The two principal indications to be met by local treatment are thorough **cleansing of the nasal cavities** and **stimulation of the mucous membrane**, for the purpose of restoring as far as possible the function of the tissues.

In order to keep the nostrils free from the accumulated discharge **thorough and persistent cleansing** is required. For this purpose **normal salt solution**, made by dissolving a teaspoonful of common salt in a pint (500 c.c.) of warm water, is quite efficient, or one of the **alkaline anti-septic solutions**, such as **Dobell's** or **Seiler's**, may be employed. When

the discharge is very offensive, a solution of **potassium permanganate**, 2 grains (0.13 Gm.) to the pint (500 c.c.) of warm water, is most beneficial. The cleansing should be carried out at home, by means of the nasal douche, which should be used two or three times a day. The patient should be instructed in the proper use of the nasal douche, so as to avoid the danger of infecting the middle ear.

At each office treatment, the **nose** should be carefully **cleansed** so that every vestige of **crust or secretion** is **removed**. If the crusts are very tenacious, their removal can be facilitated by applying **hydrogen dioxide** on a pledget of cotton and allowing it to remain in the nostril for a few minutes, after which the crusts can be readily washed out. After all the secretion has been removed, the membrane should be carefully dried and some **stimulating application** made. Of the many medicinal agents recommended for topical application, **ichthyol** is largely employed and gives most excellent results in many cases. The following formula is highly recommended:—

℞ *Ichthyolis* ʒij (8 Gm.).
Glycerini fʒij (8 c.c.).
Aquæ q. s. ad fʒj (30 c.c.).

Misce.

This should be applied over the entire surface of the nasal cavity by means of a cotton-wrapped applicator. A 25 per cent. solution of **argyrol**, applied in the same manner, is now extensively used and gives very beneficial results.

The various preparations of **iodine** have for a long time held a prominent place in the treatment of atrophic rhinitis and I have obtained very

satisfactory results from the following formula:—

℞ *Iodi* gr. v (0.3 Gm.).
Creosoti ℥v (0.3 c.c.).
Potassii iodidi gr. xxx (2.0 Gm.).
Glycerini ..q. s. ad f3j (30 c.c.).

Misce.

The 3 **Mandel solutions**, which are most generally recommended are as follows:—

No. 1.

℞ *Iodi* 3ss (2 Gm.).
Potassii iodidi 3ij (8 Gm.).
Glycerini f3v (20 c.c.).

No. 2.

℞ *Iodi* 3j (4 Gm.).
Potassii iodidi 3iv (16 Gm.).
Glycerini f3v (20 c.c.).

No. 3.

℞ *Iodi* 3iss (6 Gm.).
Potassii iodidi 3vj (24 Gm.).
Glycerini f3v (20 c.c.).

In this method of treatment, the milder solution is first applied for a short time, and the strength gradually increased until the stronger ones are tolerated. Better results are usually obtained if the stimulating applications are varied from time to time. Following the application of any of these stimulating solutions, much comfort will result from **spraying the nasal cavity with some oily solution**, such as the one mentioned under **SIMPLE CHRONIC RHINITIS** or the following:—

℞ *Camphoræ*,
Mentholis āā gr. iv (0.26 Gm.).
Petrolati liquidi f3j (30 c.c.).

Misce.

This treatment should be carried out at first every other day, and as the condition improves the interval between the visits may be lengthened.

If ulceration of the mucosa is present this should be touched with a

solution of **silver nitrate**, 60 grains (4 Gm.) to the ounce (30 c.c.).

The use of **scarlet red** as a topical application in atrophic rhinitis has been highly recommended very recently. It is applied in the form of a 5 per cent. ointment, made up with petrolatum, every two or three days, after carefully cleansing the nasal cavity. Jacobs recommends a 5 per cent. suspension in mucilage of acacia or tragacanth.

Inhalations of stimulating volatile substances obtained from the **essential oils, cubebs, tar, eucalyptus, thymol, menthol, and ammonium chloride** have been largely employed.

The insufflation of powders is recommended by some authorities, those most commonly employed being **iodoform, iodol, and aristol**.

The local application of pure cultures of **lactic acid bacilli** has recently been found to be highly beneficial by a number of rhinologists. It is claimed that the crusts liquefy and the nose presents an entirely different appearance after two or three applications. The solution is employed as a spray, or simply dropped into the nostril.

The use of destructive agents in this disease is absolutely contraindicated.

Vibratory massage of the mucous membrane has been recommended by some for the purpose of producing stimulation and secretion, but it is decidedly painful and of little value.

Electricity in many forms, such as the **galvanic current, the faradic current, and electrolysis**, has also been used, but is of doubtful benefit. The **high-frequency current** is also advocated. It is applied directly to the mucous membrane by specially de-

vised applicators. The galvano-cautery should never be employed in atrophic rhinitis.

The introduction of **tampons of cotton** into the nasal cavity, as suggested by Gottstein, for the purpose of stimulating secretion by the action of the foreign body, has been used to some extent, but, while of apparent value in some cases, the distress produced is often considerable and the method has not been generally employed.

Great discomfort is often experienced by patients suffering from atrophic rhinitis as a result of the absence of resistance to the passage of the air through the nares. To obviate this, von Eckstein, Lake and others have advocated the injection of **paraffin** into the atrophied tissues in order to build up the inferior turbinate, reduce the width of the nasal passage to its normal size, and enable the air to exercise its physiological function on the mucosa. A needle three inches long, attached to a special paraffin syringe is required. Sufficient paraffin to reconstruct the entire turbinate may be injected at one time, or a number of small injections may be made at weekly intervals. The technique is very simple. The mucous membrane over the inferior turbinate is first **cocainized**, after which the needle is inserted and passed along beneath the mucosa and the desired amount of paraffin injected.

LUPUS OF THE NOSE.

The tubercle bacillus having invariably been found in the lesion, lupus is now generally conceded to be a tuberculous disease. When occurring in the nasal mucosa, a tuber-

cular family history is often obtainable. The disease is characterized by the formation of nodules of varying size, which have a tendency to break down and ulcerate. One or both nasal cavities may be involved. The most prominent symptom is nasal obstruction, due to the nodular growth, the degree depending upon the extent of the surface involved. There is usually slight discharge, which may become fetid. Pain is not a prominent symptom of lupus of the nasal cavity, although in certain instances it may be quite pronounced.

The ulceration is serpiginous in character, healing in one direction while spreading in another. The ulcer is shallow, round or ovoid, with an elevated and indurated margin, and is usually covered with inspissated secretion in the form of brownish crusts or scales. While the affection may be primary in the nose, in the majority of cases the nasal lesion is secondary to a lesion of the skin, the involvement of the mucosa taking place by continuity. When primary, it usually begins in the mucous membrane covering the anterior part of the cartilaginous septum, from which point it may spread to the floor of the nose and the turbinates. Perforation of the cartilaginous septum usually occurs. The alar cartilages may be attacked and become more or less destroyed. Involvement of the bony structures is very rare.

In some instances, instead of going on to ulceration, the nodules become softened and undergo absorption, leaving a bluish-white cicatrix. The disease is chronic in type and runs a slow course.

TREATMENT.—This consists in thorough destruction of the lesion either by caustics, electricity or the curette. The nasal cavities should be kept clean by the use of an alkaline antiseptic solution.

TUBERCULOSIS OF THE NOSE.

Primary tuberculosis of the nose is exceedingly rare, the nasal lesion generally being secondary to tuberculosis in some other portion of the body, usually the lungs. It is due to infection of the nasal mucosa by the tubercle bacillus. The disease manifests itself most frequently in the form of ulceration, which does not differ from a tuberculous lesion elsewhere. The most common site of the ulcer is on the anterior part of the septum, probably from the fact that abrasion of the mucous membrane is so frequent in this location. It may also occur on the floor of the nose or the turbinates, and may even extend beyond the mucocutaneous junction and involve the upper lip. The ulcer is shallow, with irregular, slightly elevated edges, usually not surrounded by a zone of inflammation, and its floor is covered with a yellowish exudate, containing tubercle bacilli. Miliary tubercles may be seen upon the floor and edges of the ulcer. There is a thick, mucopurulent discharge from the nose, which may become fetid. There is little or no pain. Occasionally there is hemorrhage from the ulcerated area. The ulcers show but slight disposition to heal, and if this does take place there is a marked tendency to recurrence.

Instead of the characteristic tuberculous ulceration the disease may

present itself in the form of a neoplasm which is irregular in outline, of varying size, reddish in color, and bleeds readily. The tumor shows a strong tendency to break down and ulcerate. It consists of a round-cell infiltration, with the formation of giant cells and miliary tubercles. Small numbers of tubercle bacilli are present. As a rule the only symptoms present in this form of the disease are those due to nasal obstruction. The diagnosis is confirmed by finding the tubercle bacilli in the discharge from the nose or in the tissues.

TREATMENT.—The nasal cavity should be cleansed twice daily with an alkaline antiseptic solution. The ulcer is anesthetized by a 10 per cent. solution of cocaine, after which it is thoroughly curetted and the base cauterized with chromic acid or lactic acid. When the lesion takes the form of a neoplasm, this should be removed with the cold-wire snare, and its base cauterized. Iodoform, iodol, or aristol may be employed by insufflation. The internal administration of tonics is indicated, and if a pulmonary lesion exists appropriate treatment must be instituted.

SYPHILIS OF THE NOSE.

Nasal syphilis may be either hereditary or acquired. In the congenital form, the disease is observed at two distinct periods of the child's life. In the early form, which corresponds to the secondary stage of acquired syphilis, the symptoms usually appear from the second week to the third month, rarely later, and take the form of a severe coryza. The nasal mucosa is red and swollen, and there is a profuse discharge, at first thin and watery, which

later becomes mucopurulent. The irritating nature of the discharge is shown by the excoriation of the nasal orifices and the upper lip. In some instances the nasal secretion shows a tendency to dry and form crusts. There is marked nasal obstruction accompanied by noisy breathing, the so-called "snuffles." Mucous patches may be discovered in the nose, and occasionally the cartilages and bones become involved, with resulting deformity. When the cartilages and bones undergo necrosis, the discharge increases, becomes purulent and bloody, is very offensive, and may contain fragments of necrotic tissue and sequestra of bone. The constitutional symptoms are severe and the nutrition is further impaired by the inability of the child to nurse.

In the later form of hereditary nasal syphilis, which is analogous to the tertiary stage of acquired syphilis, the disease usually manifests itself between the third year and puberty, and is characterized by gummatous infiltration of the nasal mucous membrane, which undergoes ulceration and produces destruction of the cartilaginous and bony framework of the nose. Great deformity of the nose usually results and perforation of the hard palate may occur. The discharge is purulent, streaked with blood, and exceedingly offensive.

The nasal manifestations of acquired syphilis conform to the three stages seen elsewhere. Primary syphilis may occur in the nose, but is very rare. When a chancre appears in the nasal cavity it does not differ from the primary lesion in other locations.

The secondary stage of acquired syphilis often presents nasal symptoms, but as they are not particularly severe nor of a serious nature, they are very likely to be overlooked, the patient be-

lieving he is suffering from acute coryza. The nasal involvement develops usually within the first six months and is synchronous with the secondary lesions of the mouth, throat, and skin. The nasal mucous membrane is red, swollen, and often edematous, and there is abundant discharge, which is at first thin and watery, but later becomes thick, mucopurulent, and sometimes offensive. Mucous patches may appear on the nasal mucosa. The symptoms of coryza are persistent and do not respond to any treatment except that directed against the specific disease.

In the tertiary stage of acquired syphilis the nasal lesions are most serious and formidable, involving as they do the cartilaginous and bony framework of the nose, and possibly extending to the bones of the face and skull. As a rule, these symptoms develop after a period of from five to fifteen years. At first there is a gummatous infiltration of the mucous membrane, giving rise to local or diffuse swellings, which are red or purplish red in color, but later become pale. The symptoms of nasal obstruction are more or less marked, according to the size and location of the gummata. In the beginning these swellings are hard and do not pit on pressure with the probe, but as the disease progresses they become soft and finally ulceration occurs. The ulcer is deep, with ragged edges and surrounded by an inflammatory zone. The ulceration gradually spreads, and the surface becomes covered with a purulent and bloody secretion, which has a tendency to dry and form yellowish-green scabs. The nasal discharge is abundant, dark in color, and has a horribly offensive odor. If the probe is used the presence of necrotic cartilage or bone may be detected. The cartilaginous septum is

usually the first part to be destroyed and this results in depression of the tip of the nose. The vomer is next to be involved and the bridge of the nose becomes flattened. The turbinated bones also undergo necrosis and may disappear in part or wholly. Perforation of the hard palate frequently occurs, and occasionally perforation into the cranial cavity. The entire nose may be destroyed, leaving two gaping apertures.

The diagnosis of hereditary syphilis is usually not difficult. In the early form the symptoms are generally pathognomonic, the parental history, obstinate coryza with a purulent, irritating discharge, the general appearance of the child and the shape of the nose being the chief diagnostic features. In the later form, the marked destruction of the cartilaginous and bony structures, the characteristic offensive odor, and the history of the case should make the diagnosis clear. The disease may be mistaken for *lupus*, but it should be remembered that syphilis of the nose is rapid and very destructive, while *lupus* runs a very slow course and does not produce much deformity. Syphilis has a special predilection for the bones, whereas *lupus* attacks only the cartilages.

Owing to its rarity, the diagnosis of primary syphilis of the nose is often obscure. As a rule, a positive diagnosis is not made until the appearance of secondary symptoms. However, with our present-day methods, it is now possible to demonstrate the presence of *Spirochæta pallida* in the initial lesion.

The secondary symptoms in the nose are often so slight as to be overlooked. The diagnosis must depend upon the history, symptoms, and constitutional manifestations.

The diagnosis of tertiary syphilis of the nose is usually not difficult. The history of the case, the necrotic lesions, and the foul odor make the diagnosis clear. The Wassermann reaction is of considerable diagnostic value in all stages of nasal syphilis.

TREATMENT.—Of first importance is the administration of appropriate **constitutional treatment**, as described under the general subject of Syphilis. This should be instituted as early as possible, and the method employed will depend upon the requirements of the individual case.

The local treatment consists mainly in **thorough cleansing of the parts**. In the early stage of hereditary nasal syphilis the nose should be cleansed by means of **normal saline solution** or saturated **boric acid solution**, introduced with an ordinary medicine dropper or a small, soft-rubber syringe. In the later stage the indications for cleanliness and disinfection are even more urgent, in order to control the offensive odor and render the ulcerative process as aseptic as possible. For this purpose one of the **alkaline antiseptic solutions**, such as **Dobell's**, may be employed, or if the discharge is very offensive a solution of **potassium permanganate**, in the strength of 5 grains to the ounce of water, may be used. In primary nasal syphilis, in addition to keeping the nares clean, the chancre should be dusted with **iodoform** or **iodol**. If there is any doubt as to the diagnosis of the primary lesion, it is perhaps wise to wait until by the appearance of secondary symptoms this has been removed, when constitutional treatment should be instituted. In the secondary stage, mucous patches and ulcerations should be

cleansed with **hydrogen dioxide** and a 40 per cent. solution of **nitrate of silver** applied. The same treatment is to be applied to the ulcerative lesions in the tertiary stage. When the **cartilaginous and bony structures** are involved, they should be thoroughly **curetted** and **sequestra** of bone **removed**. If, as a result of destruction of the cartilaginous support, the tip of the nose is sunken, the **injection of paraffin** is often of great value. When the bony structures have been destroyed and the bridge of the nose flattened, an **artificial bridge** may be inserted.

RHINOSCLEROMA.

This extremely rare disease of the nose is largely confined to the inhabitants of Russia, Poland, Austria, and Southern Europe, but few cases having occurred in the United States, and these usually in foreign-born subjects. It is characterized by the formation of hard, nodular enlargement of the nasal mucous membrane and the cutaneous structures of the nose, and may extend to the pharynx, larynx and trachea.

Occlusion of the nasal cavities is often the first symptom of the disease, and on rhinoscopic examination this is found to be due to the hard, nodular swellings of the mucous membrane of both the septum and turbinates. As the condition progresses complete stenosis of the nose occurs. The disease is painless and not accompanied by nasal discharge, since the affected tissues show no tendency to ulceration or inflammatory reaction. Rhinoscleroma progresses very slowly, produces no constitutional symptoms and is not dangerous as regards life, unless the larynx or trachea becomes involved, when serious or even fatal dyspnea may

occur. Changes in the external nose occur in only a small percentage of cases.

In the light of recent investigations, rhinoscleroma is now believed to be an infectious disease, caused by the Frisch bacillus or bacillus of rhinoscleroma, which in all cases is found within the Mikulicz cells and in the surrounding tissues.

The diagnosis is not easily made, more especially in the early stages, and the clinical course must be taken into consideration, which, together with the bacteriological and histological examination, will greatly aid in arriving at a positive diagnosis.

TREATMENT.—The treatment is only palliative. Surgical interference produces no permanent results. **Mercury** and the **iodides** are recommended by some. **Vaccines** have been employed with apparent beneficial results in a few cases. At the present time the **X-ray** and **radium** seem to offer the best prospects for permanent relief.

TUMORS OF THE NASAL CAVITIES.

MUCOUS POLYPI.—While nasal polypi are usually classed under the head of Tumors, it is now quite generally believed that they are of inflammatory origin, and not true myxomatous tumors. They are generally multiple and often bilateral. In the majority of instances they originate from some portion of the mucous membrane covering the middle turbinated bone or the ethmoidal region of the nose, and occasionally from the accessory sinuses.

Symptoms.—The principal symptoms are those due to nasal obstruction and the mechanical pressure and irritation, which are brought about by the

presence of the tumors. These will vary according to the size, number and location of the growths. As nasal polypi are of slow growth and productive of no pain, there may be an entire absence of symptoms until they have attained large size. In the early stage the symptoms are usually those of simple chronic rhinitis, the patient being susceptible to frequent attacks of acute coryza. There may be occasional interference with nasal respiration, which the patient endeavors to relieve by constantly blowing the nose or trying to force air through the nose from behind. As the polypi increase in size and number, the nasal obstruction becomes more or less constant. This symptom is increased in damp weather. As a result of the nasal obstruction the patient becomes a mouth-breather, and usually complains of dryness of the mouth and more or less irritation of the pharynx and larynx. There is alteration in the character of the voice from the absence of normal nasal resonance. Impairment of the sense of smell is common. A number of reflex complications, such as cough, asthma, hay fever and neuralgia frequently occur. Nasal polypi may produce obstruction of the ostium maxillare, the nasal duct and the orifice of the Eustachian tube.

There is considerable discharge, which, though usually thin and watery, may become mucopurulent. It is rarely offensive unless there is some associated condition. In long-standing cases broadening of the nose and alteration in the facial expression may occur. In some cases cerebral symptoms are noted, such as vertigo, aprosexia, and even epileptiform attacks.

Diagnosis.—No difficulty should be experienced in making a correct diagnosis, as inspection of the nasal cavity

will reveal the characteristic appearance of the growth. They present a white or grayish, more or less transparent and glistening appearance. The masses are well defined, soft in consistency, and indent readily upon pressure with the probe. They are usually pedunculated and freely movable. The application of cocaine aids in the diagnosis by contracting the tissues and increasing the view. When the polypi take their origin from the posterior part of the nasal cavity they may not be seen by anterior rhinoscopy, even when the parts have been contracted by cocaine, but these will be discovered by examination of the posterior nares.

Etiology and Pathology.—Much diversity of opinion exists regarding the etiology of mucous polypi. Some thirty years ago Sir Morell Mackenzie made the statement that the actual pathogenesis of the disease was quite unknown, and this seems to be equally true at the present day, none of the various theories promulgated to account for their origin having been universally accepted. Most of the older observers believed that these polypi were true tumors, regarding them as myxomata or soft fibromata, and while this view is still held by a few, it has been largely abandoned. Some have considered that they were essentially granulations modified by the peculiar conditions under which they grew. Many believe that polypi are edematous hypertrophies of the nasal mucous membrane, resulting from repeated congestion in the presence of a chronic inflammation of the mucosa covering the middle turbinated bone. Yonge lays special stress upon the mechanical changes in the glands, and says they undergo cystic degeneration by obstruction of their ducts, thereby forming polypi. While the in-

flammatory origin is generally conceded, it is impossible to explain why nasal polypi do not occur in every case of chronic inflammation affecting the middle turbinate. Some authorities claim that the inflammatory condition of the mucous membrane is secondary, the polypi acting as foreign bodies.

The association of nasal polypi and suppuration of the accessory sinuses has been frequently noted, and it was formerly supposed that the polypi were primary and the sinus disease secondary, the presence of the polypi either producing an aggravated rhinitis or mechanically obstructing the openings of the sinuses, the obstruction resulting in suppurative inflammation. Now, however, many observers incline to the view that the mucous polypi are secondary to the sinus suppuration. Grünwald believes that the disease is almost invariably caused by suppuration in the nose, arising as a rule from disease of the accessory cavities. While in the cases in which accessory sinus suppuration is associated with nasal polypi there is often evidence of a causal relationship, the sinus being usually primarily affected, many cases are seen in which there is no sign of suppuration in these cavities. On the other hand, suppuration of the accessory sinuses may exist for a long period of time without the development of polypi. We also see cases of bilateral polypi with unilateral sinus suppuration.

The theory that mucous polypi are merely a symptom of disease of the ethmoid bone was first advanced by Woakes, who claimed that they resulted from a chronic inflammatory process of the mucoperiosteum of the middle turbinated bone, associated with a morbid condition of the osseous tissue, which he stated was a necrosis.

Lambert Lack has more recently revived this theory, claiming that the ordinary mucous polypus was a simple localized patch of edematous mucous membrane, which was the result of disease of the subjacent bone. To prove this Lack examined pieces of bone removed from 30 cases of nasal polypus, and in every instance he found a rarefying osteitis which began as a periostitis. The fact that nasal polypi often contain fragments of bone would seem to indicate that, at least in some instances, they originate from disease of the underlying osseous structure.

Age, race and climate seem to exercise little influence upon the development of nasal polypi. Heredity and constitutional conditions likewise seem to have no etiological bearing. Anatomical defects, such as deviation of the septum, spurs and crests, which produce obstruction of the nasal cavities, have been considered as necessary to the development of the disease. Traumatism and foreign bodies are believed to be of minor importance.

TREATMENT.—Thorough removal by surgical measures is the only method of treatment to be considered. This is best accomplished by means of the cold-wire snare, the Sajous instrument being the most satisfactory. The application of a 5 per cent. solution of cocaine will prevent pain and reduce the congestion and swelling of the tissues, so that the polypus may be easily seen. The wire loop of the snare is passed around the polypus and manipulated until it is as close to the attachment of the pedicle as possible and then gradually tightened until the growth is severed. As a rule, very little bleeding follows their removal, and this may be controlled by a tampon

of cotton saturated with **hydrogen dioxide**. The number of polypi which should be removed at one time depends entirely upon the endurance of the patient. I have frequently removed large numbers at one sitting without any marked discomfort to the patient. Three or four operations, however, are sometimes necessary to clear both nasal cavities. In removing these growths as little of the normal mucous membrane should be sacrificed as possible. After complete removal of the polypi, a careful investigation must be made to determine the presence of any underlying condition which may be responsible for the origin of the disease. It is obvious that if the polypi are caused by an inflammatory condition of the turbinated bone or disease of the ethmoid bone, simply removing the growths will not be sufficient to cure the disease and recurrence will take place. Necrosis of the **ethmoid bone** may be detected by means of the probe, and if present this should be **removed** with curettes or bone-forceps. Suppuration in the accessory sinuses or extensive necrosis in the ethmoid region may require a **radical operation**. If the middle turbinated bone is enlarged to such an extent that it produces obstruction, the mucous membrane should be dissected free from the bone and sufficient of the bony structure removed to relieve the stenosis. There is often extensive thickening of the mucous membrane covering the middle turbinated bone, and this should be treated as described under **HYPERPLASTIC RHINITIS**.

MISCELLANEOUS TUMORS.—

Fibromata of the anterior nasal cavities are exceedingly rare. They usu-

ally spring from the lower margin of the middle turbinate, the septum or the floor of the nose. The tumor is of slow growth and the symptoms presented are those of nasal obstruction and pressure upon the surrounding structures. If the growth becomes very large, there may be marked external nasal deformity. **Removal** with the cold-wire snare is the only treatment indicated. As a result of degeneration or irritation these tumors may undergo malignant change.

Papillomata.—These wart-like growths are occasionally seen in the anterior part of the nasal cavity, at the junction of the skin and mucous membrane. They rarely attain sufficient size to produce obstruction, but from their location they are subjected to constant irritation and may undergo malignant change. They should be **removed** by means of a sharp knife. The application of caustics or any form of irritant to these growths is absolutely contraindicated.

Sarcoma of the nasal cavities can no longer be considered rare, judging from the number of cases reported. The most prominent symptoms are nasal obstruction and repeated epistaxis. There is usually considerable mucopurulent discharge and there may be more or less pain, depending upon the location of the tumor. As the growth increases in size, exophthalmos; widening of the bridge of the nose and marked facial deformity may occur. The diagnosis is based upon the history and anterior rhinoscopy. The tumor is soft, bleeds readily upon being touched with the probe, and presents an appearance which does not resemble

any of the ordinary nasal tumors. The positive diagnosis must be made by the removal of a portion of the growth for microscopic examination. The prognosis is always grave. The only treatment is early and thorough **extirpation of the neoplasm**. When the growth can be reached, removal with the **snare** and subsequent **curetting** may be possible. In suitable cases it may be dissected out with the **galvanocautery knife**. As the tumor is very vascular excessive hemorrhage may occur, and when it does should be controlled by packing the nasal cavity with gauze. As a rule, however, an **external operation** will be required to completely eradicate the tumor.

Carcinoma of the nasal cavities is of rare occurrence. It is less frequent than sarcoma and, as a rule, does not develop until after the fortieth year.

The progress of cancer in this location is slow, and the early symptoms are nasal obstruction, mucopurulent discharge, and severe pain. Ulceration occurs and the soft and bony structures break down and undergo necrosis. Hemorrhage usually occurs, but is less extensive than in sarcoma. The growth may extend into the sphenoid sinus, ethmoid cells and orbit, with resulting impairment of vision and possibly exophthalmos. As the disease progresses marked cachexia appears.

The diagnosis is based upon the symptoms mentioned above and a microscopic examination of a portion of the growth. The prognosis is grave. **Radical operation** is the only treatment, but unless the nature of the tumor is recognized early, even this is useless.

SEPTUM, DISEASES OF THE. HEMATOMA.—While septal hematoma is among the unusual occurrences, it can hardly be considered rare. The most frequent cause is trauma, in the form of a blow or fall on the nose. A blow on the front of the nose is more likely to produce hematoma than a side blow, for the reason that the former may cause a separation of the two plates of the septal cartilage, permitting an effusion of blood between them. The extravasation may also take place beneath the perichondrium. Hecht believes that hematoma without apparent cause is a characteristic feature of influenza, just as the hemorrhagic tendency of influenza is manifested in the brain, ears, accessory sinuses and on mucous surfaces in general. The hematoma may subside or become infected, forming a septal abscess. The treatment consists in the **application of cold over the nose and cleansing of the nasal cavities**. If the **swelling** does not subside, it should be **incised**, the **clot removed** and firm **bilateral pressure** applied by **tampons** or some form of **tubes**.

ABSCCESS.—Abscess of the septum is by no means rare. The most common cause is trauma, which may consist either of injury to the septum or a blow on the external nose. The traumatic abscess is usually a suppurating hematoma, the formation of the pus having been antedated by the extravasation of blood from the effects of the blow. It is occasionally associated with erysipelas and may be a sequel to the infectious diseases, such as scarlet fever, measles, or typhoid fever.

In children it is more frequent during the first dentition, and especially

in those of scrofulous or rachitic diathesis, and may be associated with the purulent rhinitis of childhood. It may also be caused by diseases of the teeth. It may follow any severe inflammation of the nasal mucosa. It has been noted in children as result of foreign bodies.

Septal abscess occasionally follows the use of the galvanocautery on the nasal septum, but rarely the use of the saw or other cutting instruments.

In traumatic cases the abscess does not usually appear for some time after the injury, and there may or may not be evidence of trauma, in addition to the history. After the pus has formed there are marked redness, swelling, and edema of the mucous membrane of the septum, which obstruct the nostril on one or both sides, usually both, and can be retracted by pressure of the probe. The external nose is red, swollen and painful. Later distinct fluctuation may be detected by the probe and pointing may occur. There is probably some caries of the cartilage in most cases, but the mucoperichondrium is usually preserved intact so that regeneration takes place. Great sloughing or involvement of the bone septum is uncommon, and perforation rarely occurs.

Treatment.—The abscess should be freely incised at the most dependent portion, and the cavity washed out with hydrogen dioxide, followed by some alkaline antiseptic solution. The cavity should not be packed, but as there is a great tendency for the incision to close, a strip of gauze should be placed in the opening. The earlier the pus is evacuated, the less liability there is to destruction of the cartilage and deformity.

SPURS OF THE SEPTUM.—

These localized thickenings or projections upon the septum appear in the form of spines, crests, ridges, or rounded masses. They may be composed of cartilage or bone, or both; they occur with or without deviation of the septum. When the growth occurs upon the cartilaginous portion it is called an ecchondrosis, and when occurring upon the bony septum it is termed an exostosis. As a rule, they originate at the junction of the quadrilateral cartilage with the vomer and the spine of the superior maxilla, and also at the junction of the perpendicular plate of the ethmoid and the vomer. They most frequently extend from before backward, parallel to the floor of the nose, but may project at a right angle from the septum, and occasionally take a vertical direction. Septal spurs may be congenital, or result from malformation or traumatism. In many instances they are productive of no symptoms and do not require treatment. When they are of such size and location as to cause obstruction to nasal respiration and drainage, or, by pressure upon the adjacent turbinate, induce reflex irritation, their removal is indicated. In most cases this can be done under local anesthesia. The mucous membrane should first be dissected free from the underlying growth, before attempting its removal. This is not always an easy matter and is frequently unsuccessful, particularly when the spur is situated well back in the nasal cavity; but when it can be accomplished, healing takes place more rapidly, since the denuded area can be immediately covered with mucous membrane. After the flap of mucous

membrane has been raised, the projecting spur or ridge is removed, preferably by means of the nasal saw, although some operators prefer scissors, the biting forceps, spokeshave, or other cutting instruments. After the spur has been removed, the flap of mucous membrane is allowed to cover over the raw surface. Unless there is severe hemorrhage, the nasal cavity should not be packed.

DEVIATIONS OF THE SEPTUM.—A perfectly normal nasal septum is rarely seen, but unless the deviation is sufficiently marked to cause obstruction to nasal respiration and drainage, or to produce pressure upon the turbinates and consequent irritation, there may be no symptoms referable to the deformity. There is no doubt, however, that many of the catarrhal conditions of the nasal cavities are directly due to or perpetuated by irregularities of the nasal septum; therefore, the early recognition and correction of injurious deformities is of utmost importance. No satisfactory classification of deviations of the septum can be made. They may involve the cartilage alone, or the cartilage and bone, but are rarely limited to the bony septum. They may be horizontal, vertical, oblique, or sigmoid; they are often associated with spurs or crests, and they may or may not be accompanied by external deformity.

Symptoms.—Many of the minor degrees of deviation are quite free from active symptoms, and even in the more severe types the external deformity may be the only sign of the abnormality. When symptoms are present they are those of nasal obstruction with its effects upon both the adjacent structures and

distant organs. The symptoms of obstruction here do not differ from those due to nasal stenosis from other causes. Nearly always there is marked enlargement of the turbinal tissues on the concave side, which is of the nature of a compensatory hypertrophy, and patients, therefore, not infrequently complain more of obstruction on this side than upon the opposite, which is really more occluded. In cases in which the deviation is of the sigmoid type, both nostrils may be obstructed by the deformed septum. When the cartilaginous septum has been dislocated, the anterior margin of the cartilage projects prominently into the opposite nostril from the deflection, producing partial or complete occlusion of this side as well. External deformity of the nose is present in some cases, especially in those of traumatic origin. The contact between the deviated septum and the turbinates produces a chronic congestion probably quite as much from the irregular atmospheric pressure as from irritation, and this gives rise to repeated attacks of acute rhinitis. As a result of the chronic rhinitis, as well as from the mouth-breathing, the patient is subject to frequent attacks of pharyngeal and laryngeal inflammation, which eventually become chronic. The voice is altered from the lack of normal nasal resonance due to the nasal stenosis. The patient may also suffer from tinnitus aurium and impairment of hearing from interference with the proper ventilation of the Eustachian tubes. From reflex irritation there may be present such symptoms as cough, headache, hay fever, asthma, and neuralgic pains about the face.

The character of the deviation may be readily determined by anterior rhinoscopy; a convexity will be seen in one nostril, with a corresponding concavity in the other. There is usually considerable thickening at the point of greatest convexity. In the concave side prominent spurs or crests are frequently seen running horizontally along the sutural ridge, which unites the septum with the superior maxilla.

Etiology.—From the numerous theories which have been advanced as to the etiology of septal deformities, it would seem that the question has not been definitely settled and that no one etiological factor has been generally accepted. I believe that the condition may result from any one of a number of different causes, and that it is very difficult to determine the actual origin of any given case. Whether the deviation has been occasioned by congenital causes or faulty development in early life, or results from pressure from an enlarged turbinated bone, or whether it is brought about by one of a large variety of traumatic influences, is simply a matter of conjecture.

Some hold that heredity is the chief cause of septal deformities. Talbot believes that they are due to neuroses or stigmata of degeneracy, which cause either an arrest or an excessive development of the bones of the face, including the nose, one of the expressions of the neurosis being deformed septa. That a large proportion are due to congenital conditions or irregular development in very early life is probably true. Mosher claims that delayed eruption of the incisor teeth can displace the premaxillary wings and distort the

vomer groove, resulting in spurs and causing deviations anteriorly and posteriorly. Irregular development from different centers of growth would be sufficient to produce deviation of the septum from the median line.

The presence of adenoids in early childhood, with the associated mouth-breathing and the subsequent frequent attacks of acute catarrhal rhinitis, is undoubtedly a very potent factor in producing deviation of the septum. The high-arched, narrow palate which results raises the floor of the nose and thus diminishes the vertical diameter between the base of the skull and the nasal floor in which the septum must develop. This shortened diameter necessitates curvature of the nasal partition if it continues to develop.

Pressure from enlargement of the inferior or middle turbinated bones, as well as nasal tumors, polypi or foreign bodies, may be sufficient to push the septum out of alignment. Again, a single nasal passage may be occluded, which would tend to an overdevelopment of the free nostril with a resulting deviation of the septum toward the occluded side.

Many observers believe that traumatic causes are by far the most frequent. In a great many cases there is a history of trauma, but actual fracture or dislocation of the septum is not of common occurrence, and blows are rarely so severe at the time that they produce deformity. It is probable that in many instances the traumatism occurs in early childhood, while the bones are still soft, and since little attention is given to it at the time, the injury may be entirely forgotten when the nasal obstruction manifests itself. The fact

that men are much more commonly affected than women would tend to sustain the traumatic hypothesis. When the nasal septum is markedly deflected from the median line and there is no history or evidence of adenoids, and the palate is not high and arched, we may conclude that traumatism has probably been the cause of the condition.

Treatment.—Nothing short of **surgical treatment** is productive of good results when the septum has become deflected sufficiently to demand interference. A great many operations have been devised for this purpose, the deformities being so varied that no one method is applicable to every case. Many of them differ only in some slight modification of technique. It may be said, however, that all operations proposed for the relief of this condition have the same general principles, namely, that of removing the redundant tissues; breaking up the resiliency of the septum; conserving the mucous membrane, and restoring the septum, as nearly as possible, to a normal position. A few of the more important operations may be briefly described as follows:—

The Asch Operation.—Although enjoying less popularity now than it did in the early days of nasal surgery, the operation devised by Dr. Morris I. Asch, of New York, for the correction of septal deflections is still valuable in certain selected cases.

A special set of instruments is required for this operation and it is performed under general anesthesia. The blunt separator is introduced into the deviated side in order to break up any adhesions that may exist and also to ascertain the presence of any bony obstruction pos-

teriorly. Should such obstructions be found the sharp separator can be used for their removal, or it may be accomplished by an ordinary small bone chisel. The scissors is now introduced in a line parallel to the floor of the nose, the sharp blade being in the concavity and the blunt blade over the line of greatest convexity of the deviation; it is important that the blades should be at a right angle to the septum at the place of incision, as otherwise they may override and the scissors fail to cut through. The blades being firmly closed, the sharp one cuts through the cartilage into the opposite side with a distinct snap. The scissors is then opened and completely withdrawn. It is immediately reintroduced in the same manner as before, the blades this time pointing in a vertical direction, crossing the line of the first incision as near as possible at right angles and at its center; the scissors is now closed and the second incision made, after which the scissors is opened and withdrawn. We have thus four segments as the result of the crucial incision. The operator now introduces his finger into the stenosed nostril and forcibly pushes the segments into the concavity of the opposite side, effectually breaking them at their base. This part of the procedure must be done thoroughly and carefully, for on it depends the success of the operation. If the segments are thoroughly broken at their bases the resiliency of the cartilage is destroyed and the deviation cannot recur. The compressing forceps is now introduced, one blade in each nostril, and the septum compressed in order to straighten it still further

and force the broken segments so that they will more completely override each other. An iced antiseptic solution is now sprayed into the nostrils to check the bleeding, and the sterilized tubes are introduced, a snugly fitting tube into the side previously stenosed and a smaller one in the opposite. These serve to prevent hemorrhage and hold the septum in its new position. The patient is now placed in bed and iced compresses are applied externally. The patient should be kept in bed for two or three days, the cold compresses being applied externally during the first twenty-four hours. The nasal cavities should be sprayed through the tubes with an antiseptic solution. Twenty-four hours after operation the tube in the previously concave side is removed and not replaced. Twenty-four hours later the tube in the previously stenosed side is removed, the nostril cleansed, and the tube sterilized and replaced. This tube may be withdrawn daily for a week, and then on alternate days and gradually at lengthening intervals until healing is complete.

The Watson Operation.—A bevelled incision is made on the convex side of the septum, from behind forward and just beneath the angle of deflection, following the angle to its anterior extremity and then curving upward for a short distance. The incision is not carried through the mucous membrane of the opposite side. The upper part of the septum is then pushed over the lower portion into the opposite side, thus overlapping the lower portion. The same principle is applied when the angle is perpendicular, the incision then being made behind the angle from

above downward, the bevel at the base, forward from the first incision, forming a triangular flap. The posterior edge of the anterior portion is then pushed over the posterior portion. If both horizontal and perpendicular angles exist, both incisions are made, meeting at the base. The anterior fragment is first made to overlap the posterior, and then the upper portion, including the anterior segment, is made to overlap the basal portion. This forms a double locking and holds the anterior portion, which has no other support, firmly in a straight line. When the deflection extends into the bony septum, this is broken and replaced with forceps, there being no need for cutting or overlapping of the bony portion, as the fragments slide on each other and take up the redundancy, and, as the union is bony, there is no tendency of the deformity to return. The projecting base is removed after the parts have healed.

The Gleason Operation.—A thin saw is introduced along the floor of the nose beneath the deviation; the sawing is begun in a horizontal direction until the blade has penetrated somewhat deeply into the tissues, when the direction is rapidly changed from horizontal to nearly vertical. It is of the utmost importance that the saw should be held exactly parallel to the septum, in order that the cut shall be around and not through any part of the deviation. The length of the vertical crus is then quickly increased by means of a small bistoury curved on its flat, and the flap is thrust through the hole in the septum with the forefinger. While the finger is still in the nares it is carried up along the

anterior and posterior crura, in order to be certain that the edge of the flap has completely cleared them, and the neck of the flap is then sharply bent. It is not necessary to denude the edges that are in contact, as the pressure results in necrosis of the superficial epithelial layer of the mucosa, after which the parts unite.

The Kyle Operation.—This consists in making a horizontal V-shaped cut on the concave side of the septum by means of the triangular saw-file, which should not involve the mucous membrane of the opposite side. This V-shaped cut is made at the base of the septum on the concave side, while a straight saw-cut is made at the upper portion of septum on the convex side, for the purpose of breaking up the resiliency. The septum is then forced into the median line by the finger or forceps, after which it is supported by a metal splint in the previously occluded nostril.

The Roe Operation.—This is adapted to deviations of both the cartilaginous and the bony portions of the septum. A pair of fenestrated forceps are used, one blade of which is made in the form of an ovate ring, termed the ring or female blade, and the other is made in the form of a long, narrow, rounded blade, termed the single or male blade. The ring blade is introduced on the concave side, the single blade on the convex side, and pressure applied to the curved portion to press it into position. When this is done in the bony portion of the septum, the redundance is accommodated by the impaction and crowding together of the fragments, if sufficiently comminuted by the forceps. If the deviation in the cartilaginous portion is large, it may be necessary to incise the cartilage obliquely in order

to overcome the redundancy by allowing the severed portions to overlap.

Submucous Resection of the Septum.—This operation, which was first devised by Killian, of Freiburg, and afterward modified by Freer, Ballenger and others, has largely supplanted many of the older methods. Local anesthesia is employed. The nasal cavities should be thoroughly cleansed with an alkaline antiseptic solution and the mucosa thoroughly swabbed with a 1:1000 solution of adrenalin chloride to constrict the capillaries before the cocaine is applied. This decreases the liability to toxic effects from the cocaine. The mucosa is anesthetized by applying pledgets of cotton saturated with equal parts of a 10 per cent. solution of cocaine and a 1:1000 solution of adrenalin chloride. These are allowed to remain in place for fifteen minutes, after which powdered cocaine is rubbed into the entire mucosa by means of a cotton-wrapped applicator. A self-retaining nasal speculum is now introduced and a vertical incision made in front of the deviation on the convex side, beginning at the upper part of the septum and extending to the floor of the nose. The mucous membrane, perichondrium and periosteum of the corresponding side are then separated from the cartilage and bone by means of special elevators, which should be moved in an upward and downward direction in their long axis in order to prevent injury to the mucous membrane. This having been accomplished, a vertical incision is made through the cartilage to the perichondrium of the opposite side, following the line of the primary incision in the mucous membrane. A small elevator is then passed through the incision in the cartilage and the mucous membrane, perichondrium, and periosteum sepa-

rated as on the opposite side, great care being exercised in order to avoid injury to or perforation of the mucous membrane.

After the mucoperichondrium and periosteum have been separated from the septum on both sides, the Killian nasal speculum is introduced, one blade passing through the cartilaginous incision, while the other is placed beneath the membrane first elevated, which leaves the septum between the two blades, the mucous layers on the outside.

The cartilage is now removed either piecemeal with the cutting forceps, or preferably *en masse* with the Ballenger swivel knife. The next step consists in the removal of the deflected portions of the vomer, the perpendicular plate of the ethmoid and the maxillary ridge. This is accomplished by means of sharp-cutting forceps. In order to gain access to the maxillary ridge a sharp separator is often necessary for the purpose of separating the periosteum along the floor. The maxillary ridge is removed either with cutting forceps or the Killian chisel and a mallet. When all the cartilage and bone involved in the deviation have been removed, the field of operation is cleansed by douching with warm normal saline solution and the edges of the incision approximated. Both nasal cavities are packed with sterile gauze, or Bernays's intranasal tampons may be used.

The packing is removed at the end of twenty-four hours and the nose douched twice daily with normal saline solution, the patient being cautioned against forcibly blowing the nose. If the mucous membrane has not been injured the parts usually heal in a week or ten days.

FOREIGN BODIES IN THE NASAL CAVITIES.

Inanimate foreign bodies are frequently introduced into the nose by young children and insane persons. These consist of peas, beans, beads, buttons, fruit-stones, pebbles, coins, and, in fact, any object whose size will permit of its lodgment within the nasal cavity. In adults they occur as the result of external violence, such as gunshot wounds, explosions and similar injuries. Foreign bodies may also enter the nasal cavity by way of the nasopharynx, during vomiting, or sudden sneezing, or coughing during the act of swallowing. It sometimes happens that pieces of cotton or gauze are left in the nose and forgotten, later giving rise to trouble. Nasal plugs occasionally become pushed so far back in the nasal cavity that their removal is very difficult.

The symptoms are nasal obstruction, pain, epistaxis, sneezing, and a serous discharge. The affected side may be more prominent than the other, especially when such substances as peas, beans, etc., which have a tendency to swell, are present. These may even germinate. When the foreign body has been allowed to remain for any length of time, the discharge becomes mucopurulent and offensive, and abscess formation and necrosis of the cartilages and bones may occur.

When no history of a foreign body can be obtained, examination of the anterior nares with the aid of the probe will establish the diagnosis.

Removal is obviously the only treatment indicated, but this is not always easily accomplished, especially when the foreign body is imbedded in the

tissues and there is marked inflammatory reaction. The nasal cavity should be first sprayed with a 4 per cent. solution of **cocaine**, after which the object may be grasped with strong forceps and withdrawn. The introduction of the finger into the nasopharynx, for the purpose of pushing the foreign body forward, will often aid materially in its removal. When the object is round and smooth, so that it cannot be grasped with forceps, a small curette or hook may be passed beyond it and the foreign body drawn out. In some cases it is necessary to push the foreign substance into the nasopharynx and remove it by this route.

Animate foreign bodies, such as insects, maggots, and screw-worms, sometimes gain access to the nasal cavity, or the larvæ develop as a result of the deposition of the ova by certain flies. They give rise to severe inflammation of the nasal mucous membrane, with resulting pain, itching, and sneezing, accompanied by a bloody, purulent discharge and, frequently epistaxis. External swelling may also occur. These parasites may feed upon the tissues, causing an ulcerative process. The ulceration may not only involve the mucous membrane and underlying bone, but the inflammation may extend to the meninges and bring on a fatal issue.

These **parasites** or their **larvæ** should first be **killed** by the injection of a 50 per cent. solution of **chloroform**, after which they may be **removed** by means of the **nasal douche**, the **curette** or **forceps**.

RHINOLITHS, or nasal calculi, usually contain an inorganic foreign body as a nucleus around which the

salts are deposited and form a concretion. The symptoms are practically the same as those mentioned under inanimate foreign bodies. They can usually be **removed** with forceps, but if they are very large it may be necessary to first **crush** them with strong forceps **before** their **removal** can be accomplished.

NASAL NEUROSES.

SENSORY NASAL NEUROSES.

—**Anosmia**.—Loss of the sense of smell is infrequently observed, though its impairment through any local disorder is quite frequent. Mechanical obstruction of the nasal cavities by growths, especially nasal polypi, which prevents the odoriferous particles from coming in contact with the olfactory areas; inflammatory disorders of the nasal mucous membrane, acute or chronic, by causing infiltration of the tissues surrounding the olfactory fibrils, impair their sensitiveness and thus give rise to anosmia. Cerebral diseases of various kinds, cerebral tumors, locomotor ataxia, syphilis, lead poisoning, malaria, the excessive use of tobacco, the prolonged use of snuff, the constant inhalation of irritating fumes, etc., may be mentioned as among the many etiological factors of this disorder. The duration depends upon the cause; cases due to nasal growths usually recover their sense of smell soon after removal of the neoplasms, even though the latter may have been present a long time. Anosmia due to central disorders follows the course of the latter. **Measures** calculated to **remove** the **causative factors** are obviously indicated. Cases due to syphilis often promptly yield to **potassium**

iodide. **Strychnine** in full doses is of great benefit.

Hyperosmia.—Abnormal sensitiveness of the sense of smell is rarely observed, and is usually associated with hysteria, neurasthenia, hypochondria, menopause, and other conditions in which the nervous system is in a state of temporary or permanent adynamia. It sometimes occurs as an excessive physiological development, the sense of olfaction resembling that observed in some of the lower animals, especially dogs.

Parosmia (disordered or perverted sense of smell, the patient complaining of foul, peculiar, or pleasant odors) is a symptom occasionally observed in acute or chronic catarrhal disorders of the nasal cavities, syphilis of the nose, and of cerebral tumors when these directly or indirectly involve the olfactory bulb.

Parosmia is in almost all cases due to some definite local pathological condition and in a large proportion of cases to suppuration of the accessory sinuses of the nose, mostly of the antrum of Highmore. It may be one of the first symptoms of insanity. It may also be caused by infections and drug poisoning. Kahn (Ills. Med. Jour., Sept., 1908).

It often accompanies such neuroses as hysteria, epilepsy, insanity, neurasthenia, and locomotor ataxia, and is sometimes observed during pregnancy, the menopause and uterine disorders. Here also the **cause** must be **ascertained and removed**. Syphilitic parosmia quickly yields to **antispecific treatment**; but when it is due to cerebral tumors it follows the course of these.

Spasmodic Sneezing.—This represents but a manifestation of a physiological function repeated frequently or

continuing beyond the usual limits. It may be caused by an hyperesthetic state of the pituitary membrane coupled with the presence of foreign substances capable, by their shape, of keeping up a titillation of the epithelial surfaces. It may be caused reflexly through the eyes, by sunshine, pregnancy, the menopause, etc. The condition appears to be due to a temporary adynamia of the reflex centers. This is sustained by the fact that **tonics** and **stimulants** are usually beneficial.

Reflex Nasal Neuroses.—These are usually ascribed to an impulse starting from the termination of a nerve of nasal mucous membrane through the intermediary of a sympathetic center, and giving rise to morbid phenomena at a point more or less distant from the nose. Epilepsy, neuralgia, facial spasm, etc., have thus been traced to nasal disease. Whether the peripheral nerve-filaments, the nerve-trunk, their ganglia, or the entire system is at fault is hardly determinable.

Reflex disturbances of the eyes are frequently observed as a result of hyperplastic rhinitis, atrophic rhinitis, polypi, etc. Cases of ciliary neurosis have been cured by division of nasal synechia. The connection between the nose and the eye mainly depends upon the branch of the ophthalmic division of the fifth nerve. Cutaneous disorders are sometimes ascribable to nasal disease, especially the group known as the angioneuroses, including urticaria, herpes, pemphigus, erythema, etc.

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NOSE-BLEED. See EPISTAXIS.

NOVOCAINE. —Novocaine, or procaine, a widely used local anesthetic, is chemically para-aminobenzoyldiethylaminoethanol hydrochloride: $\text{CH}_2\text{-(C}_6\text{H}_4\text{.NH}_2\text{.COO).CH}_2\text{[N(C}_2\text{H}_5\text{)}_2\text{].-HCl}$. It crystallizes from alcohol in fine, colorless needles, which are soluble in an equal part of cold water and in 30 parts of alcohol. The solution in water is neutral in reaction. From it the free base is precipitated if caustic alkalies or alkali carbonates are added; sodium bicarbonate can be added, however, without causing any precipitation or turbidity. Alkaloidal reagents such as potassiummercuric iodide and picric acid cause precipitation even in very dilute solutions of novocaine. The drug is advantageous in that its solution may be heated to boiling without decomposition. In dry form novocaine can be heated to 120° C. without decomposing.

PHYSIOLOGICAL ACTION.—In its general effects when absorbed into the system, novocaine resembles cocaine. A cardinal difference between the two, however, lies in their relative toxicity, novocaine causing death only in doses six or seven times as large as in the case of cocaine.

Locally, novocaine acts like cocaine, exerting a prompt and pronounced anesthetic action. It is non-irritating, causing no after-pain, and has no tendency to cause, as does cocaine, tissue necrosis. According to J. F. Mitchell its action is somewhat slower than that of cocaine; in most cases, however, its less toxicity more than makes up for this disadvantage.

Experimentation led to classification of the different local anesthetics or combinations thereof as

follows in the order of decreasing strength. (1) Cocaine. (2) Novocaine-epinephrin. (3) Novocaine; alypin. (4) Stovaine; tropacocaine; beta-eucaine.

As regards the intoxication determined by intravenous injections in rabbits, following results were obtained: Alypin, fatal dose per kilo, 0.017 Gm.; cocaine, 0.0183 Gm.; beta-eucaine, 0.019 Gm.; tropacocaine, 0.02 Gm.; stovaine, 0.03 Gm.; novocaine-epinephrin, 0.046 Gm.; novocaine, 0.063 Gm.

Novocaine-epinephrin is thus a very active agent and next to the least toxic. Piquand and Dreyfus, cited by M. V. Tyrode (Boston Med. and Surg. Jour., July 7, 1910).

POISONING.—Only in rare instances are unpleasant secondary phenomena witnessed in the use of novocaine for local anesthesia. In administering 5000 injections of the drug, Fischer failed to note a single case of serious intoxication. In a few instances, however, an idiosyncrasy to novocaine has been observed, toxic manifestations such as rapid pulse, pallor, cold perspiration, and tremor being present. Occasionally a species of "hypnosis," with unconsciousness of the patient but retained ability to follow the operator's instructions, has been noticed. Faintness, vomiting shortly after injection, impairment of accommodation, headache, a feeling of warmth of the body, spasms, and paresthesias are among the commonest toxic effects of novocaine.

According to Braun, 1.25 Gm. (20 grains) of novocaine can be injected without fear of intoxication, *e.g.*, 250 c.c. (8 ounces) of a ½ per cent. solution or 125 c.c. of a 1 per cent. solution. With a 2 or 4 per cent. solution, however, he considers it

advisable not to exceed 0.8 Gm. (12 grains).

THERAPEUTICS.—Novocaine has achieved popularity as a local anesthetic mainly because of its low toxicity, and the fact that its solutions can be sterilized by boiling without deterioration. Balfour, of the Mayo clinic, reports uniformly satisfactory results from the use of novocaine in various types of operations performed under local anesthesia.

Report of results obtained in the Mayo clinic with novocaine. The largest group of cases is made up of those in which the operation entails no exploration, is expected to be simple, and is not prolonged. In this group belong ligation of arteries, particularly of the thyroid; removal of small breast tumors, superficial cysts, lipomas; circumcision; paracentesis; external hemorrhoids; drainage of abscesses; excision of isolated glands and specimens of tissue for diagnosis; tonsillectomy in the adult, and various operations on the nose and throat.

Another group is composed of cases in which general inhalation anesthesia is preferable but might, for some reason, be deleterious to the patient. In this class are patients with recent acute condition of the lungs, alcoholism, nephritis, myocarditis, etc., or any complication which renders ether inadvisable. Hernia, hydrocele, varicocele, tuberculous epididymitis, varicose veins, and similar conditions are very satisfactorily operated on under local anesthesia. In operations on the thyroid where there is present an unstable nervous system and marked degenerative change in the heart and kidneys, local anesthesia is also preferable, unless there is an apparently unreasonable degree of mental excitement. In thyroid surgery it is satisfactory to make the skin incision and divide between the muscles in the midline,—if necessary cutting the

sternohyoid and sternothyroid,—under local anesthesia. An excellent exposure of the gland can thus be obtained painlessly. After beginning the actual extirpation of the gland, it is well to allow the patient to decide whether the pain is unbearable; if so, a few inhalations of ether will quiet him.

Several abdominal operations were performed under novocaine alone, among them being appendectomies, gastrojejunostomies, gastrostomies, cholecystectomies, and the removal of ovarian cysts. A chronic appendix can be satisfactorily removed through a split-muscle incision if it is not markedly adherent. On the other hand, should old firm adhesions be present and considerable traction be necessary to free the appendix, severe pain will be produced which cannot be controlled by any method of injecting an anesthetic.

In acute abscesses, superficial growths and lipomas, it is best to encircle the field of operation at the base with substantial infiltration, then wait five or ten minutes before proceeding. For ligation of the superior thyroid vessels, injection along the line of incision of about 15 c.c. (4 drams) of the solution, 10 c.c. (2½ drams) posterior to the outer limit of the proposed incision, to block off the superficial cervical nerves in that region, and another 5 or 10 c.c. (1¼ or 2½ drams) deeply around the superior pole of the gland, usually give a perfect anesthesia despite the fact that these patients are extremely irritable mentally. For thyroidectomies the same general plan is followed except that the deep injections around the gland, when it is exposed, are not employed. In herniotomy, after the inguinal canal is opened, the cord and sac should be infiltrated as high as possible. The separation of the sac can then be accomplished within a few minutes with very little pain, and a high removal done with surprising ease to the patient. In intra-abdominal work, it is simple to cut through the abdominal wall to

the peritoneum without producing pain, but anesthetizing the latter is difficult and oftentimes inefficient. In the more extensive types of operation morphine, $\frac{1}{6}$ grain (0.01 Gm.), either alone or, in the case of the hyperplastic goiters, combined with $\frac{1}{200}$ grain (0.0003 Gm.) of scopolamine was given. D. C. Balfour (St. Paul Medical Journal, February, 1914).

A $\frac{1}{2}$ per cent. solution of novocaine is the weakest generally used, though Hoffman and Kochman affirm that by the addition of 2 per cent. of potassium sulphate the novocaine can be reduced to 0.1 per cent., and Gros asserts that upon addition of 1 part of sodium bicarbonate for every 4 parts of novocaine employed the anesthetic effect of the latter is at least doubled or trebled. Epinephrin (adrenalin, suprarenin, etc.) is generally added to solutions of novocaine in order to bring about vasoconstriction, the anesthesia being thus prolonged and the operative field rendered almost bloodless.

Solutions of novocaine-epinephrin may be prepared from tablets containing the two agents in the required ratio for the preparation of given amounts of solution. Such tablets, however, are not certainly sterile; boiling of the solution before use is therefore required, and since epinephrin preparations deteriorate upon boiling, it is preferable to make up a solution of novocaine in normal saline first (either from tablets or the crystalline drug), boil this solution, and finally add the required amount of a 1:1000 solution of epinephrin. Braun recommends that 1 c.c. (15 minims) of 1:1000 suprarenin solution be added, respectively, to 200 c.c. (50 drams) of $\frac{1}{2}$ per cent.

solution of novocaine, to 100 c.c. (25 drams) of a 1 per cent. solution, to 50 c.c. (12½ drams) of a 2 per cent. solution, or to 25 c.c. (6¼ drams) of a 4 per cent. solution. A dropper may be used to add the suprarenin solution, provided the number of drops required to make up 1 c.c. (15 minims) with the particular dropper used has been previously ascertained. A fresh mixture should be made before each operation.

Novocaine-epinephrin local anesthesia is available for a wide range of operative procedures, including many major operations. In the latter, solutions containing $\frac{1}{2}$ per cent. of novocaine are mainly used. The 1, 2, and 4 per cent. solutions are reserved generally for the anesthetization of single large nerve-trunks and for cases in which a rapid and intense action is required. The $\frac{1}{2}$ and 1 per cent. solutions can be employed almost *ad libitum*,—an advantage in that a wide infiltration of the operative field, with liberal blocking off of the sensory nerve supply, can be effected. Novocaine is not only suitable, however, for infiltration and nerve blocking, but is also used with success in terminal anesthesia (injection into or immediately under the skin), for anesthesia of the mucous membranes, etc. In rhinolaryngology 5 to 10 per cent. solutions may be employed, and for anesthesia of the larynx and pharynx, 10 to 20 per cent. solutions, with a small amount of epinephrin added, are recommended. In dental practice, 1 or 2 per cent. novocaine solutions are employed. The drug is also extensively used in spinal anesthesia (*q. v.*). The use of novocaine in intravenous anesthesia, as well as the

manner of use of cocaine and other drugs in the production of local anesthesia in its various modalities, have been discussed in the article on COCAINE, to which the reader is referred for details not here presented.

Inflammations are favorably influenced when the pain is reduced by artificially induced anesthesia. By abolishing the reflexes emanating from the focus of inflammation through the centripetal sensory nerves, it is possible to prevent the development of inflammation or to cure it if already existent. Insufflation of a local anesthetic (orthoform) every five minutes will abort incipient sore throat or coryza, and by injection (novocaine) will abort furuncles and styas. Ordinarily, after tonsillotomy, the raw surfaces are soon covered with a membrane and severe pain is experienced for two days. If an analgesic drug be employed after the operation at regular intervals the patient will be comfortable and the wound heal with but little reaction. The same principle may be applied to the larynx and to all wounds and sores upon the skin. G. Spiess (Münch. med. Woch., Feb. 20, 1906).

In the course of a review of the uses of novocaine in local anesthesia, the author summarizes various special procedures as follows:

Frontal Sinus Operation.—Make a skin wheal over the suture between the nasal bones at their tips, another at the side of the nose at the same level, a third over the exit of the supratrochlear nerve from the orbit, one corresponding to the notch of the supraorbital nerve, one at the external angle of the eye, one about three finger-breadths above the last on the forehead, and the last in the middle of the forehead 3 inches above the root of the nose. Connect all wheals subcutaneously, using 1 per cent. novocaine solution. Now at the inner orbital angle introduce the needle along the inner orbital wall to a depth of $4\frac{1}{2}$ cm. and inject 2 c.c.; after withdrawing the needle

about 2 cm. inject 1 c.c. more. The nasal mucous membrane is to be painted with 10 per cent. alypinephrin solution.

Gasserian Ganglion Anesthesia.—Introduce the needle opposite the alveolar process of the second molar tooth, patient's jaw being closed. Then with the finger in his mouth, constantly avoiding the mucous membrane, guide the needle between the coronoid process of the inferior maxilla and the tuber maxillæ. Now incline the needle slightly upward and inward until it reaches the plate on the under surface of the sphenoid. At a depth of 6 cm. the needle engages the foramen ovale. When one strikes the region of the opening the patient has violent pain in the lower teeth. Now push the needle in $1\frac{1}{2}$ cm., when the patient will experience pain in the upper teeth; then inject 2 c.c. of a 2 per cent. solution of novocaine-epinephrin and the anesthesia will be complete in a few minutes.

First or Ophthalmic Branch of the Trigemini.—Make a median orbital injection at a depth of $4\frac{1}{2}$ cm.; also inject along the lateral wall. The medial wall injection catches the ethmoidal branches; the lateral, the frontal and zygomatic nerves. Use about 2 c.c. of a 1 per cent. solution of novocaine on each side of the orbit.

Second Branch of the Trigemini.—Infiltrate with 5 or 6 c.c. of a 2 per cent. solution. Go in below the malar process to a depth of about 5 or 6 cm.; keep close to the tuber maxillæ and above the lateral tooth row. To make sure one is not in the internal maxillary artery, put on syringe and aspirate. A skull should always be beside the patient's head.

Third Branch of the Trigemini.—This may be blocked either at the foramen ovale by the same technique as for Gasserian ganglion anesthesia, or its mandibular branch may be blocked just before it enters the bony canal of the inferior maxillary bone.

Resection of Lower Jaw or Tongue.—Give a hypodermic of morphine.

atropine or morphine-scopolamine. Block the lingual and alveolar nerves. From a midpoint just above the hyoid bone infiltrate the base of the tongue under guidance of the left finger placed in the mouth, thus blocking the ninth nerve and making the tongue and gums almost bloodless. Paint the pharynx with 10 per cent. cocaine to obliterate reflexes.

Operations on the Neck.—The most important part of the infiltration is along the posterior border of and through the sternocleidomastoid muscle down to the transverse processes. This, plus a thorough subcutaneous and subfascial injection encircling the area, gives an excellent anesthesia. From 50 to 60 c.c. of a $\frac{1}{2}$ per cent. solution should be injected along the posterior border of the sternocleidomastoid muscle. One needs from 120 to 130 c.c. for an operation.

If the floor of the mouth is to be included, block both linguals or inject the floor of the mouth from a central point above the hyoid bone.

Thyroidectomy.—Make a six-sided figure with one side corresponding to the posterior border of the sternocleidomastoid. One point should be over the middle line of the neck at the isthmus of the gland. Inject 50 to 60 c.c. along the posterior border of the sternocleidomastoid. Connect subcutaneously and subfascially all six points. Infiltrate under the isthmus. The vertical lines of infiltration are the most important, as they cross the nerves. One hundred to 150 c.c. are usually required for this operation, using 16 drops of adrenalin to each 100 c.c. of novocaine solution. Wait at least fifteen minutes before operating.

Glands of Neck.—Infiltrate behind sternocleidomastoid, form six-sided figure, and connect up all points around. Inject several lines across the direction of the nerves, thus connecting points up and down the neck.

Excision of Breast.—Begin in the axilla and completely encircle the breast subcutaneously with a $\frac{1}{2}$ per

cent. solution. Inject 3 to 5 c.c. in each intercostal space to block the intercostal nerve. Strongly abduct the arm and inject 40 to 50 c.c. of a $\frac{1}{2}$ per cent. solution of novocaine under the pectoralis major as high up as the first rib, to block the brachial plexus. Wait fifteen minutes for anesthesia.

Brachial Plexus Anesthesia.—Find the pulsating subclavian and make a skin wheal just to its outer side. Use a 4-cm. needle and pass it in the direction of the second or third dorsal spine. Pain in the fingers or elbow occurs when the plexus is struck. Inject from 10 to 20 c.c. of a 2 per cent. solution. The anesthesia reaches up to the middle of the upper arm and muscular relaxation occurs from the shoulder down. Use a Martin bandage because of undue congestion of the arm.

Sciatic Nerve.—Pass a finger into the rectum to palpate the nerve, and under this guidance pass a needle through the gluteus muscles directly into it. Upon injection of 2 or 3 per cent. novocaine, anesthesia is complete in from three to five minutes.

Fractures.—The injection of 20 to 30 c.c. of a 1 per cent. solution about the ends of the bones produces muscular relaxation and makes reduction painless.

Dislocation of the Hip.—Braun injects 25 c.c. of a 1 per cent. solution about the head of the bone, and 20 c.c., from close behind the anterior superior spine of the ileum, into the acetabulum. Reposition is easier than under narcosis.

Abdominal Wall.—Make subcutaneous and subfascial injections, then infiltrate under the peritoneum. If necessary one may infiltrate subperitoneally after the incision is made. One should make a large hexagon, so that if necessary the incision can be made larger. There is little danger of puncturing the intestine, for it slips away. Use 100 to 150 c.c. of a $\frac{1}{2}$ per cent. solution. Always precede with morphine-atropine or morphine-scopolamine.

Hernia, Inguinal.—Make the first skin wheal about two finger-breadths above the anterior superior iliac spine, infiltrating across the nerves toward the anterior superior iliac spine and also in the opposite direction. The second wheal is placed one finger-breadth below the middle of Poupart's ligament, the third wheal over the spine of the pubis, and the fourth internal to the ring. To complete the rhombus connect all wheals subcutaneously. Now inject deeply into the muscles and subfascially along these lines. From the first point inject subfascially downward to the outside of the external ring, and also to the inside of the external ring. Insert the finger into the canal and inject the structures that form it. Inject the spermatic cord with 5 c.c. ($1\frac{1}{4}$ drams) of a 2 per cent. solution containing 5 drops of adrenalin 1:1000.

Keep on exerting steady pressure on the piston while injecting the cord to prevent injury to the pampiniform plexus. It usually requires from 100 to 150 c.c. (25 to $37\frac{1}{2}$ drams) of a $\frac{1}{2}$ per cent. solution to inject the field.

Hernia, Femoral.—Make a four-sided figure about the tumor, watching always the positions and relations of the larger vessels. The first wheal should be placed about two finger-breadths medial to the anterior superior iliac spine, the second over the spine of the pubis, the third over the junction of the middle and outer thirds of Poupart's ligament, and the last at the femoral opening. Connect all wheals subcutaneously and subfascially. From the second and third wheals inject about the neck of the sac, and from the fourth try to get under the sac. About 75 to 100 c.c. (19 to 25 drams) of a $\frac{1}{2}$ per cent. solution are required.

Genitourinary Operations.—Local anesthesia for operations on the scrotum and testicle can be utilized in tuberculosis, syphilis, varicocele, and hydrocele, but is contraindicated in malignant disease where the glands

are to be removed. It is possible to anesthetize the whole external genitalia in the male. Make a wheal at the base of the penis, two lateral to it, and two or three on the perineum. Connect all wheals and inject the area where the scrotal skin joins abdominal skin.

The cord should always be injected separately with 5 c.c. of a 2 per cent. novocaine solution containing 5 drops of epinephrin 1:1000. For infiltration of the area about 100 c.c. are required.

Hydrocele.—Inject above and below the scrotal partition. Should the sac not be thoroughly anesthetized fill it up with novocaine solution and clamp opening for a few minutes.

Suprapubic Prostatectomy.—Make a hexagon on the abdomen and inject subcutaneously and subfascially down to the peritoneum. Inject 20 c.c. into the space of Retzius. Now inject, under the guidance of the finger, in the rectum 5 or 10 c.c. of a 1 per cent. solution between the rectum and prostate on each side, and, finally, fill the bladder with a 1 per cent. alypin-epinephrin solution.

Circumcision.—Put a constrictor at the root of the penis. Make four wheals and connect around the penis subcutaneously; then infiltrate down to the corpora cavernosa. Do not use too much fluid, as it might cause gangrene from fluid pressure. Do not use epinephrin. To amputate the penis use the above technique plus through and through injections of the corpora cavernosa.

Hemorrhoids and Fistula.—Make four or six wheals about two finger-breadths from the anal opening; connect these subcutaneously. To relax muscles and anesthetize mucous membrane make a cone of infiltration with the rectum as a center. Under guidance of the finger inserted inside inject deeply about the rectum. It requires 100 to 125 c.c. of a $\frac{1}{2}$ per cent. solution. Do not dilate sphincter widely, but use retractors. G. F. Bicknell (Southern Med. Jour., March, 1914).

In anesthetizing fingers by Oberst's method a 1 per cent. solution of novocaine is sufficient. Upon injection of a ring of the solution around the base of a finger or toe the part will become anesthetic in about ten minutes. Combination of epinephrin with the novocaine renders the use of a constricting band at the root of the member unnecessary.

In infiltration anesthesia five to thirty minutes should be allowed to elapse before the operation is begun. Where novocaine solution is injected directly into nerves the anesthesia is not at its height for ten to fifteen minutes. The duration of novocaine anesthesia, without epinephrin, is about fifteen minutes; with epinephrin, about two hours.

Following used for paraneural anesthesia: Novocaine, 2 Gm. (30 grains); sodium chloride, 0.5 Gm. ($7\frac{1}{2}$ grains), and distilled water, to 100 c.c. ($3\frac{1}{3}$ ounces). To this is added, immediately before use, epinephrin in the proportion of 5 drops of a 1:10,000 solution to each 20 c.c. (5 drams) of solution.

Injection of the intercostal nerves posterior to their lateral cutaneous branches is recommended for certain cases. This is accomplished by injecting just in front of the angle of the rib. The needle is introduced through the skin, while the patient lies on his face with the arm raised, at a point a little below the level of the desired rib. It is passed obliquely upward until it touches the lower border of the rib; then it is withdrawn a fraction of an inch and the point depressed a little, when it is again pushed forward. When the point just misses the lower border of the rib the needle is pushed on for about $\frac{1}{4}$ of an inch, well into the subcostal groove, and the injection made. This anesthetizes the entire thickness of the chest wall, from the midline in front to within a few inches of

the midline behind, and affords a valuable means of performing almost any operation on the thorax or the contained organs, while obviating the dangers of general anesthesia. Felix Rood (Brit. Med. Jour., Dec. 21, 1912).

Extradural anesthesia with novocaine recommended in operations in the sacral region, all rectal and vaginal operations, and, with the addition of slight general anesthesia, in Alexander's operation and operations for hernia and on the bladder. The author uses, as a rule, 20 c.c. (5 drams) of a 2 per cent. solution, injected slowly (in two or three minutes), due care being exercised to avoid getting inside of the dura. Bleek (Monats. f. Geburtsh. u. Gynäk., Jan., 1913).

The writer prefers novocaine-adrenaline or novocaine-suprarenin. Under local anesthesia he has carried out major operations such as arm amputations, foot amputations, appendicitis, ovarian cyst, etc. In 900 operations carried out during the war he has used local anesthesia in about three-fourths of the cases. Regnault (Presse méd., p. 396, 1917).

Internally, novocaine may be used for local analgesic purposes in doses not exceeding $7\frac{1}{2}$ grains (0.5 Gm.).

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NUCLEINIC ACID. See NUCLEINS.

NUCLEINS.—Nuclein is the principal proteid found in the nuclei of the cells of plants and animals or of yeast. It is an amorphous substance rich in phosphorus. On boiling with alkalies phosphoric acid is set free. Physiologically, nucleins may be said to form the chief chemical constituents of the living parts of cells. The number of kinds of nucleins is limited only by the varieties of cells. Chemically, the nucleins

are complex proteid bodies characterized especially by the large amount of phosphorus they contain. The phosphorus exists in the form of nucleinic acid, which is combined with a highly complex basic substance, the nucleinic acid of all nucleins being the same, the basic portion differing in the various nucleins. The basic substance, on decomposition, yields one or more of the xanthin bodies.

The nucleins in general are insoluble in dilute acids and soluble in dilute alkalies; hence they resist peptic digestion and in this way may be separated from most other proteid bodies.

Certain substances, histologically and functionally nucleins, do not yield any xanthin base (adenin, guanin, sarcin, xanthin) as a decomposition product. These are called *paranucleins*. Some of these are the antecedents of true nucleins. Some nucleins are combined with albumins, forming compounds known as nucleoalbumins. When one of these bodies is submitted to peptic digestion, the albumin is converted into a peptone, and the nucleins form an insoluble precipitate (Vaughan).

The nucleins may be obtained from many sources—from yeast, casein, the nuclei of blood- and pus- corpuscles, the liver, the spleen, bone-marrow, the thyroid and thymus glands, the testicles, the brain, the cells of plants and grains, or any structure containing numerous cell elements.

PREPARATIONS AND DOSES.—

While no preparation of nuclein is official, there are on the market several which may be used. These are variously *thymus* (Parke Davis Co.) or *spleen nucleins*; a proprietary known as "*protonuclein*" (Reed and Carnrick); a *nuclein solution* for internal use containing 5 per cent. of nucleinic acid from yeast; a *special solution* of nuclein, also 5 per cent., for hypodermic use; a *sodium nucleinate*, a yellowish powder prepared from nucleinic acid of yeast (Merck). It is readily soluble in water. There is also a *sodium tritico-nucleinate* (Abbott) derived from the wheat germ. The dose varies according to process of manufacture. The dose of nuclein, nucleinates and nucleinic acid is from 8 to 15 grains (0.5 to 1 Gm.).

PHYSIOLOGICAL ACTION.—The most prominent action of nuclein or nucleinic acid is believed to be stimulation of glandular activity with increase of polymorphonuclear leucocytes. Germicidal properties are attributed to it. The pulse is increased in frequency, as a rule, within three to five hours, the temperature rising concurrently about one degree F. The phosphorus content of the urine is increased, the absorption occurring mainly from the intestine through the action of the pancreatic juice.

Series of experiments upon guinea-pigs, to ascertain if nucleinic acid injections are capable of increasing the number of leucocytes in the circulating blood. In one series of experiments upon 24 of the animals they found that intraperitoneal and subcutaneous injections of the acid caused first a brief hypoleucocytosis, followed by hyperleucocytosis lasting about seventy-two hours. Diez and Campora (*La Quinzaine Thérap.*, viii, 95, 1907).

Nucleinic acid injected into the animal organism exercises a distinct influence upon the zymotic power of the cells. This action is more marked after intravenous than after subcutaneous administration. The amylolytic ferments are most markedly influenced. In the brain of animals treated with nuclein the amylolytic power was increased 400 times; in the lungs, the increase was 250 times; in the muscles, 6.4; in the thymus, 2.5. Sodium nucleinate administered continuously, and often in enormous doses, to animals was not found to exert any harmful action upon the organism. Aschernorurzki (*Biochem. Zeitsch.*, Bd. xxxvi; *La Quinzaine Thérap.*, March 25, 1912).

THERAPEUTICS.—Nuclein has been used with apparent benefit in **septicemia**, in **amygdalitis** and **pharyngitis**, in **pseudodiphtheria**, and as a dressing and injection for **indolent ulcers**. It was used successfully in a **progressive anemia**, in the treatment of which all the other remedies used had failed.

In cases of **diphtheria**, **scarlet fever**, and

measles, the injection of a nuclein solution seemed to abort the attack and quell the complications. The dose given was 5 minims (0.3 c.c.) of nuclein solution. **Hip-joint disease** is sometimes improved by the systematic use of nuclein injections every second day (Hitchcock). It has been used apparently with profit in **paralytic disorders** due to suboxidation, and also in **periodical insanities**.

Of 17 patients 1 only reacted to nucleinic acid injections by a slight improvement. In several **psychoses**, however, the writer obtained good results with this treatment. The author was led to use it by the consideration that psychoses are sometimes favorably affected by a severe infective disease, so that an appreciable benefit might arise from an artificially produced severe reaction of the organism in which the polynuclear leucocytes were concerned. For this purpose he used injections of sodium nucleinate.

The dose generally used by the author was 50 c.c. of a 1 to 5 per cent. solution. The results were specially good in **acute and subacute mania** and in **periodic insanity**. In **dementia precox** and **degenerative delirium** the results were satisfactory, while there was practically no effect in epilepsy, senile dementia, delusions of persecution and morbid fear. J. Lépine (Lyon méd., No. 9, 1910).

The action of injections of nucleinic acid, sodium nucleinate, or of tuberculin appears to depend on an increased oxidation process. Though the action is similar, nucleinic acid has the advantage of being non-poisonous. In 70 per cent. of the paralytic patients in whom it was used, injections of a 2 per cent. sodium nucleinate solution led to a decided improvement, while in 50 per cent. of the cases the patients were able to return to work. Injections were given at intervals of five to seven days. On an average eight applications and 8 Gm. (120 grains) of sodium nucleinate were required. The following solution was used:—

Sodii nuclein. gr. xxx (2 Gm.).
Sodii chloridi gr. xxx (2 Gm.).
Aq. dest. steril. . . . 3iii½ (100 c.c.).

No harmful secondary effects were observed. J. Donath (Allg. Zeit. f. Psych. u. psych.-gericht Med., Nu. 3, 1910).

The claims that nucleinic acid was of value to prevent postoperative complications have not been sustained by extended experience. On the whole, the use of preparations of nuclein has greatly diminished in recent years.

Preliminary injection of nucleinic acid as a prophylaxis of peritonitis was given a thorough trial in von Eiselberg's service at Vienna, but the conclusions are unfavorable. In 1056 laparotomies done under the prophylactic injections the mortality from this cause was 4.6 per cent., but in a later series of 775 laparotomies, in which it was not used, the mortality averaged only 2.7 per cent. E. v. Graff (Mitteil. a. d. Grenzgeb. der Med. u. Chir., xxiv, Nu. 3, 1912).

Contraindications.—Nuclein should not be given for long periods to gouty persons, as the researches of Horbaczewski, Weintraud, and Richter show that the administration of nuclein, or of foods containing a large proportion of nuclein in their composition, increases notably the formation of the alloxuric bases the cause of the symptoms ascribed to uric acid.
 S.

NURSING AND ARTIFICIAL FEEDING.—BREAST-MILK.—

Physical Properties.—Breast-milk is slightly bluish and opalescent; it is sweet, amphoteric to litmus, slightly acid to phenolphthalein. Under the microscope are seen fat-droplets and granular matter; if milk from the colostrum period is examined, there are also epithelial cells and leucocytes undergoing fatty degeneration, —“colostrum-corpuscles,”—and the fat-droplets are found of varying sizes.

Chemical Composition.—The nutritive ingredients are:—

1. WATER, constituting from 85 to 90 per cent.

2. FAT, in the form of minute globules held in emulsion by the soluble proteid. If the milk stands, the fat collects at the top as cream. In a good specimen the percentage varies from 3 to 5, the average being about 3.5. The fat is made up chiefly of neutral fats, olein, palmitin and stearin, the olein predominating. Small amounts of fatty acids, chiefly the lower or volatile forms, are present.

3. SUGAR.—The carbohydrate of breast-milk is lactose, or milk-sugar. Its proportion is remarkably constant: 6 to 7 per cent. during the whole nursing period.

4. PROTEIDS.—Casein and lactalbumin are the principal forms. The lactalbumin is in solution, and is the more readily digested and absorbed; its amount is about twice that of the casein. The casein is in suspension, and is readily precipitated; the curd formed by adding acetic acid to breast-milk is in fine flocculi, thus differing from that of cows' milk, which comes down in dense masses. In a good specimen the proteids vary from 1 to 2 per cent., the average being about 1.25 per cent. In abnormal specimens the variations range from 0.7 to 4.5 per cent.

5. SALTS.—The most important salts are calcium phosphate and potassium carbonate. Altogether the salts amount to about 0.2 per cent.

The salient points of difference between the human and cows' milk seem to be: Human milk contains relatively more of its mineral matter in utilizable form than cows'

milk. It can supply the organism of the child with relatively larger amounts of available alkali in proportion to the proteid than cows' milk. It contains much less proteid. It contains a more readily absorbable variety of fat. An infant fed on cows' milk receives, therefore, an excessive amount of proteid, and the amount of alkali is insufficient for the proper digestion and metabolism of the proteid and fat. J. H. Kastle (*Amer. Jour. of Physiol.*, July, 1908).

CLINICAL EXAMINATION.—

While a complete chemical analysis of the milk is desirable, this is often impossible; and the physician must depend on his own simple tests.

The quantity may be estimated from the amount which can be drawn with a breast-pump; but the most reliable test is to weigh the infant before and after nursing, on scales sensitive enough to record differences of half an ounce. The average result of two or three such weighings will be sufficiently definite.

Infants getting proper and adequate nourishment usually present on each side of the abdomen, low down, a slight protuberance.

This is probably due to the relaxed condition of the abdominal wall in very young infants which allows it to bulge when a filled loop of intestine presses against it.

This little bulging is constantly observed in young infants thriving on proper nourishment. The absence of the bulging therefore is an early sign that the child is not getting enough food. Gismondi (*Pediatrics*, Jan., 1918).

The quality of the milk, or, at least, whether very rich or very poor, can be estimated by the following procedures:—

Development of the Breasts.—Breasts rich in glandular elements secrete the best milk. The conical

breast which is not very large, and has but little fat, is usually the best form.

Number of Childbirths.—This has an influence only in so far as it affects the general health of the woman. The milk is apt, however, to give out earlier with each successive lactation. Frequently, however, a mother may have been unsuccessful in nursing her first and even second baby and may succeed admirably with a later one.

Acute Illness.—If mild and of short duration, there is no lasting effect; if severe and prolonged, the milk is reduced in quantity, the fat becomes low, and the proteids often high. In septic and suppurative disease bacteria may be found in the milk.

Diet.—A generous diet increases the fat and the proteids. A nitrogenous diet, consisting largely of meat, milk, eggs, beans, peas, etc., increases the fat more than the proteids; but, if the nurse takes little exercise, there is apt to be an excess in the proteids also. Large quantities of liquid increase the amount of milk; but the percentage of solids is diminished. Malted drinks increase the quantity, and raise the proportion of fat. If the diet is low, the milk becomes scanty, the fat is diminished, and the proteids usually diminish; if increased, they are often changed in character. No matter what the diet, the percentage of sugar remains practically unchanged.

Drugs.—Only a few drugs are with certainty eliminated by the breast, and these in varying proportions. Alcohol, opium, atropine, chloral, and the iodides may be given off in an amount sufficient to cause symptoms in the nursling; likewise rhubarb,

senna, castor oil, and the saline cathartics. Occasionally the salicylates, copaiba, colchicum, antipyrin, turpentine, iron, and arsenic are eliminated in appreciable quantities. Mercury is excreted only in very small amount, after prolonged administration.

Exercise.—The quantity of the milk is usually increased, and the proteids diminished by moderate exercise.

Nervous and Emotional Disturbances.—There are few influences that affect the milk so immediately and so strikingly as nervous impressions. Grief, anger, fright, passion, great excitement, and fatigue are apt to have a prompt and decidedly bad effect; so that the infant may be actually poisoned, and have an attack of severe acute indigestion, which may be accompanied by convulsions. The change in the milk is probably in the proteids, toxic nitrogenous bodies being formed. The specimen taken for examination should be the entire amount of milk that can be pumped from one breast.

Estimation of the Fat.—A cylindrical glass tube, holding 10 c.c. and graduated to hundredths, is filled with breast-milk and allowed to stand at ordinary room temperature for twenty-four hours: then the percentage of cream is read off. Under such conditions the percentage of cream is to that of fat approximately as five to three; thus, 5 per cent. of cream indicates 3 per cent. of fat, etc. Accurate results may be obtained by the Babcock test or by Lewi's modification of the Leffman and Beam test for cows' milk.

Estimation of the Proteids.—So far as the proteids are concerned, it is possible to distinguish only between

conditions in which they are very high and very low. The sugar and salts are present in so nearly constant proportions that their variations may be regarded as having practically no effect on the specific gravity. If, then, the fat is high, and the specific gravity is high, the proteids may be assumed to be in excess; if the fat is low, and the specific gravity low, the proteids may be assumed to be in too small proportions.

[Simple apparatus devised by author for the clinical examination of breast-milk consists of a lactometer and a graduated tube. The milk to be examined is either the entire specimen at a single nursing or a specimen taken as near the middle of the nursing as possible. The specific gravity is first taken; then the milk is put into the graduated tube up to the 100 line, and allowed to stand for twenty-four hours on the physician's table, at which time the amount of cream which has risen can be read off as hundredths. A good average milk has a specific gravity of about 1030, with about 8 per cent. of cream. Provided the specific gravity and the percentage of cream do not vary materially from these figures, it may be inferred that the amount of proteids is normal. L. EMMETT HOLT.]

Bacteria.—No germs are found in normal human milk if the skin of the breast has been cleaned and the first drawings have been discarded. Only in case of suppurative or tuberculous disease of the breast or some general microbic disease does the milk in the lobules contain bacteria.

Practically the final test of the breast-milk is its effect upon the baby. The milk may be perfectly normal, so far as can be determined by chemical analysis, and yet may disagree with and even poison the baby. If there has been a careful effort to adjust the quantity given at each feeding and the intervals of the nursings to the

baby's comfort, and indigestion persists, it is necessary either to modify the breast-milk by giving the baby barley-water before the nursings or to change to another wet-nurse or to bottle food.

Elimination of Antitoxin and Other Protective Substances.—Diphtheria antitoxin is eliminated in the milk of immunized animals, and the Widal reaction may be obtained with milk of patients suffering from typhoid fever and with the blood of their healthy nursing infants. It is probable that other protective alexins are eliminated by the mammary gland.

CONDITIONS WHICH AFFECT THE COMPOSITION OF BREAST-MILK.—**Age and Constitution of the Nurse.**—The milk of a woman between 20 and 35 years is richer in fat than at other ages. Moreover, a robust constitution contributes to an abundant milk-supply; still, many delicate-looking women make good nurses.

Menstruation.—Comparatively few infants are very much affected by the return of menstruation. The quantity of the milk is often diminished and its quality impaired for the first day or two of the menstrual period.

The writer found 79 menstruating in 180 women about the sixth month after childbirth. The menstruation was not quite normal, but no interference with the nursing capacity was observed. The children increased in weight even when there was profuse menorrhagia in nearly every instance. The majority of the children showed transient disturbance, restlessness, or a tendency to diarrhea or dyspepsia, and in a few cases they vomited milk, but these were all temporary. Jacobius (*Archiv f. Kinderheilk.*, Bd. xlviii, Nu. 1, 2, 1908).

Pregnancy.—If pregnancy supervenes, the milk deteriorates steadily in quantity and quality.

NURSING.—"Will the mother be able to nurse the baby?" is a question the physician must frequently answer nowadays when an infant is born.

Irrespective of any good explanation, it is a fact that each year there are fewer women that can nurse their babies. In some conditions nursing is either impossible or inadvisable; in others the question can be answered only after a trial.

At the Tarnier clinic the proportion of morbid processes in the breasts was about 10.2 per cent. of the 5746 women who were able to nurse their children. The majority were observed in the spring. They coincided with uterine infection in from 10 to 22.6 per cent. of the cases in the various years. Breast nursing was apparently normal in 87.5 per cent. of the women who had had but a single attack of lymphangitis; in 57 per cent. of those with recurring lymphangitis; in 68.7 per cent. of those with galactophoritis, and in 40 per cent. of those with mammary abscess. Jeannin (*L'Obstétrique*, vol. x, No. 4, 1905).

Physicians should exert their influence in inducing mothers to nurse their infants. In civilized countries only 30 to 55 per cent. of the mothers supply their children with breast-milk, and 74 per cent. of the deaths of infants between the ages of 2 weeks and 1 year are in the artificially fed. J. P. Crozer Griffith (*N. Y. Med. Jour.*, June 8, 1912).

There is no question that the ability to nurse an infant successfully is to a large extent a matter of inheritance. It is probable that a line of mothers who, though able, practise voluntary refusal to suckle their offspring finally develop an acquired characteristic which can be transmitted, resulting in inability in the

mothers of the younger generation to perform the maternal function of nursing. J. P. Crozer Griffith (*Trans. Med. Soc. State of N. Y.*; *Med. Rec.*, Sept. 21, 1918).

Conditions in which Nursing Should Not be Attempted.—1. If there is no milk secreted.

The writer has been able to have women nurse their infants, even after the child has not been nursing for several weeks, and even in women who have not nursed the infant at all after its birth, the interval ranging from three to twenty-six days. Jacobius (*Archiv f. Kinderheilk.*, Bd. xlviii, Nu. 1, 2, 1908),

Maternal nursing may be re-established through the regular suckling of an infant, even though several months have elapsed since the breasts were used for this purpose. Wile (*Jour. Amer. Med. Assoc.*, Mar. 16, 1912).

2. If tuberculosis is present in any form.

3. If there is malignant disease of the breast, or if there have been serious complications of parturition, as hemorrhage, eclampsia, nephritis, or septicemia.

4. The presence of chorea, epilepsy, or insanity precludes nursing.

In the above-mentioned conditions nursing is deleterious to both the mother and the child.

The writers know of no instance in which the *Spirochæta pallida* has been found in the milk of syphilitic women, but they have induced syphilitic lesions in rabbits by inoculations with milk from eight syphilitic parturients, although microscopically the milk was sterile. In one of the positive cases the woman was free from symptoms of syphilis, but her child had signs of the disease. This confirms the view that the symptomless mothers of syphilitic children have the disease in a latent form, harboring the active virus. Research

on gastric juice showed that it rendered the spirochetes non-motile in a few minutes. Uhlenhuth and Mulzer (*Deut. med. Woch.*, May 8, 1913).

Conditions in which Nursing is Not Likely to be Successful.—1. If, on previous occasions, under favorable conditions the mother has been unable to nurse.

2. When the woman is of a very delicate constitution and highly nervous.

In the writer's experience the proteids have been increased during such nerve upsets; not that this was the only change, but it was the most palpable one; it is his custom to increase the number of bottle feedings temporarily (if the child had been fed on mixed feedings), and also to try to get a higher fat and lower proteid in the mother's milk. C. A. Frost (*Med. Rec.*, May 24, 1913).

If nursing is attempted in these circumstances, the baby's weight and general condition should be carefully watched. The usual custom is to continue nursing as long as the infant thrives, but the mother's condition should be watched with equal solicitude, lest she be injured by continuing the nursing too long.

A prime factor in milk secretion is preservation of a normal psychic state. With an insufficient supply, *supplemental* feedings should be tried. Sometimes even this may be avoided by nursing from both breasts at one feeding. Griffith (*Med. Soc. St. of N. Y.*; *Med. Record*, Sept. 21, 1918).

CARE OF THE NURSING WOMAN.—Diet and Mode of Life.

—The nursing woman should have a generous mixed diet, not excessive in nitrogenous food nor in vegetables. She should drink from a quart to a quart and a half of milk or milk-gruels daily. Meat, eggs, such cereals as

oatmeal, rice, hominy, etc., bread, potatoes, all the common vegetables, and fresh fruits are allowed. Very highly seasoned foods, salads, cabbage, tomatoes, stale or unripe fruits, alcoholic drinks, strong tea, and coffee are forbidden. Whatever disturbs the mother's digestion is apt to produce a bad effect upon the milk, and should therefore be avoided.

The mode of life should be simple, with regular exercise,—by driving, early, or by walking, later, as soon as returning strength will permit. There should be no anxieties nor great excitement.

Breasts and Nipples.—At least a month before confinement the nipples should be examined, and, if flat or depressed, they should be drawn out and the woman instructed to do this herself several times a day. If the nipples are hard, **borated vaselin** or **lanolin** should be rubbed on them four or five times daily; if soft and macerated, they should be painted three times a day with equal parts of 50 per cent. **alcohol** and **glycerin**.

During the whole of lactation the nipple should be cleansed with 2 per cent. **boric acid solution** before and after nursing, and the breasts supported in a well-fitting corset. Slight excoriations are well treated by dusting them freely after each nursing with **bismuth carbonate**; for fissures probably the best treatment is to paint with an 8 per cent. **nitrate of silver** solution once or twice a day, and either to use a nipple-shield or stop nursing for a time from the affected breast.

It is necessary, in the majority of cases, to use nipple-shields because of the small size of the nipples as well as because of fissures.

NURSING RULES FOR HEALTHY INFANTS.—Regular hours are very important, and should be adhered to from the beginning. This practice will do much to establish regular habits of sleep and regular movements of the bowels. If the child is asleep it should not be allowed to go beyond the regular nursing time for more than half an hour, but be awakened. From the outset, moreover, the infant should take **boiled water** from a bottle at least once a day, not only for the water, but also to learn to use the **rubber nipple**.

Variot's teaching to "let the child on the breast drink according to its appetite" is sustained by a large series of personal cases, all of which were conducted along this plan. It was found that the infant mortality did not exceed 4.5 per cent., being only 3.14 per cent. in 1912. The amount of milk thus taken by the child may vary from one-sixth to one-twelfth of its body weight in twenty-four hours, and is never so low as one-tenth, as is generally taught. If the child has taken a little too much there is simple regurgitation. The restricted feeding advocated by many almost always leads to underalimen-
tation, with crying, vomiting, diarrhea, wasting, etc. D. H. D. Cran (Lancet, June 14, 1913).

It is generally not necessary to put the child to the breast until three or four hours after birth; and even then it should be allowed to nurse only about five minutes. Aside from the fact that the breasts contain little milk until the third day, the nipples should be gradually accustomed to their function. After the second day the child may nurse from ten to twenty minutes.

The number of nursings a healthy infant should have in twenty-four hours, together with the intervals and

the number of night-nursings, is given in the subjoined table.

SCHEDULE FOR BREAST-FEEDING.

Age.	Number of Nursings in 24 Hours.	Intervals During Day (hours).	Night-nursings Between 9 P.M. and 7 A.M.
First day	4	6	1
Second day	6	4	1
Third to twenty-eighth day	8	2½	2
Fourth to thirteenth week..	7	3	2
Third to fifth month	6	3	1
Fifth to twelfth month.....	5	4	0

During the first few days of life, if the infant seems unsatisfied, the nursings may be supplemented by giving from 1 to 1½ ounces of warm, sterile, 5 per cent. milk-sugar solution; this is made by dissolving an even table-spoonful of milk-sugar in 7½ ounces of boiling water, and may be given from the bottle. It will frequently prevent the marked loss of weight and "inanition fever" which often occur when the breast-milk is scanty.

During the early weeks of life, in the children of one category only, —namely, the children of primiparous women where there is weakness or difficulty in suckling or a hypogalactorrhea on the part of the mother, the intervals between the feeding times for infants have gradually been increased in both Austria and Germany, pediatricians in those countries having shown that children thrive much better upon 5 meals per day than upon the 8 or 10 which were usual in those countries and are still most frequently prescribed in England. This does not mean that the children get absolutely less food, for Czerny found that in the average case the total amount of milk taken in the day was fully as great as in the case of the more frequent meals, only that the child took rather more at a meal. H. Riethschel (Jahrb. f. Kinderheilk., April and May, 1912).

SIGNS OF SUCCESSFUL NURSING.—The following are the important features to be considered:

Weight.—All infants should be weighed once a week, and feeble infants twice a week during the first six months. A loss in weight during the first three or four days is normal, and amounts to about one-tenth of the infant's birth weight. After about a week the regular gain for the first five months should be about 6 ounces per week; from the sixth month to the end of the first year there should be an average gain of from three-fourths of a pound to a pound per month. At five months the average healthy infant should have doubled its birth weight, and at one year should have trebled it. It is to be noted that the gain during the second six months is more apt to be irregular, due to dentition, end of lactation, etc.

A greater birth weight is to be expected in the children of multiparæ than in those of primiparæ, the difference ranging from 2 to 12 ounces. In general, the robustness and health of the mother may affect the initial weight of the infant. Griffith and Gittings (*Archives of Pediat.*, 1907).

The writer had an infant carefully weighed before and after each nursing for a period of seven weeks, beginning on the fourth day after birth. The results show that there is a general increase in the average daily consumption of milk from week to week, but that this is neither uniform nor uninterrupted. David Forsyth (*Lancet*, June 14, 1913).

Not only should the child gain in weight, but the flesh should be firm, and the cheeks, ears, and lips of good color.

Length of Time and Manner of Nursing.—The infant should always be ready to nurse at the proper time,

but not overgreedy; and it should be satisfied after nursing ten, or at most twenty, minutes. Satisfaction is shown by relinquishing the breast voluntarily, and then either falling asleep or remaining contented and happy while awake.

The crying of the infant when it does not get enough food at a meal, its restlessness and its gradual exhaustion and dropping to sleep, make a picture which is very different from the fatigue and slumber of the well-fed, healthy child. Even during its sleep the child is still restless, and it whimpers at times, while the slightest noise rouses it, when it appeals anew for the nourishment it needs without having the strength to make its appeals very insistent. There is also a marked tendency to false constipation, not enough food being obtained to make normal stools; the walls of the intestine, suffering from lack of nourishment, grow too weak to move the feces along. Merklen (*Bull. de la Soc. de Pédiat.*, Dec., 1910).

Vomiting.—There should be no true vomiting; but there may be regurgitation of small quantities of milk almost immediately after nursing,—due usually to overdistention of the stomach, or to the eructation of swallowed air. To prevent this, the baby should be **held over the shoulder in the midst or immediately after the nursing** and then be put in a **semi-reclining position** or even **lying on the face**. This permits the gas and swallowed air to escape from the stomach.

Occasional regurgitation in infants is physiologic, but habitual regurgitation indicates that the child is getting too much food. Breast fed children are the ones that present it most frequently, as they can tolerate overfeeding longer. Repeated hic-coughing also indicates that even if

the food is well digested, the child is getting too much. Excessive drooling has the same significance. Moderate drooling may occur because the infant does not know how to swallow saliva. It may accumulate in the mouth and throat and make the breathing noisy, suggesting stridor, etc. Up to the fourth or fifth month very little saliva is secreted. After this, coryza or adenoids may force the child to keep its mouth open and all the saliva may drool out. Marfan (Nourisson, Jan., 1919).

Stools.—There should be from one to three easy, natural movements daily; soft, smooth, and free from large or hard curds. The presence of soft yellow or soft white curds in healthy nursing infants is so common that it must be regarded as within the range of normal. Similarly the appearance of green stools is usually due to a change in the bile coloring matters from fermentation of the sugar. Moreover, many stools that were yellow on being passed turn green if left in the diaper for some time. After the disappearance of the meconium, about the fifth day, their color should be light orange or yellow. Normally their reaction is acid.

During the first few weeks of life the infant has from 3 to 5 loose golden-yellow stools daily. Gradually after this time the stools become fewer in number and of a salve-like consistency, so that at about the third month they are reduced to 2 or 3 daily. The color is due to bilirubin. The reaction is acid, due to the relative excess of fat over protein in the milk. Sometimes the stools are brown in color; when this is the case, the milk was relatively high in proteins. The presence of small curds and a small amount of mucus in breast-fed infants' stools does not usually interfere with an infant's gain in weight and comfort. Weston (Med. Record, Jan. 20, 1917).

Sleep and Disposition.—During the first few weeks infants should sleep nearly all the time they are not nursing; at six months considerably more than half the time; and from then on until a year old they should take both a morning and an afternoon nap.

It is normal for a baby to cry from fifteen to thirty minutes daily; but fretfulness, peevishness, and sleeplessness, with crying, are abnormal conditions.

Development.—With successful nursing there should be the signs of normal healthy development. In the muscles this is shown by the child holding up its head at the fourth month or earlier, sitting with the back unsupported at the eighth month or earlier, standing by the ninth month, and beginning to take steps by the end of the first year.

Dentition should be regular, the lower central incisors appearing before the ninth month, and the upper incisors before the end of the year.

SIGNS OF UNSUCCESSFUL NURSING.—**Temperature.**—During the first four or five days the most important sign of insufficient food is a rise of temperature: "inanition fever," so called. It is probably due essentially to lack of fluid, since infants that receive plenty of water do not show it. The range may be from 101° to 102° F. (38.3° to 38.9° C.), or in extreme cases from 104° to 106° F. (40° to 41.1° C.). If no obvious symptoms of illness are present, such a temperature before the fifth day may be regarded as due to inadequate nursing.

Weight.—Failure to make the proper gain, if not accounted for by existent disease, is nearly always due to inadequate nourishment.

Length of Time and Manner of Nursing.—If the infant habitually remains at the breast for more than twenty minutes; or if, after taking the breast with avidity, it soon turns away fretting, only to resume in a minute or so, and finally gives it up disgusted and crying, the milk is probably too scanty. Sometimes the same thing is indicated by the baby refusing to take the breast. On no account should such an infant be pacified by letting it sleep on the breast or by giving it a rubber nipple.

Vomiting.—A few infants thrive, in spite of considerable regurgitation. But, if the vomiting is between feedings and habitual, the sign is important.

One should always keep in mind the possibility of pyloric stenosis when a breast-fed baby has obstinate vomiting.

Colic.—If only occasional, colic does not mean much, even though severe; but the baby that has continual discomfort, with more or less flatulence, is not getting the proper kind or quantity of milk, or it is being fed too frequently.

To prevent colic in the nursing infant the writer renders the intestinal flora less liable to decomposing changes by giving $\frac{1}{2}$ to 1 ounce (15 to 30 c.c.) of 3 to 4.5 per cent. of a **warm cereal gruel** immediately **before** each **nursing**, except the night nursing, and before each and every nursing if necessary. His results were excellent. Very few infants of whatever age have any perceptible difficulty in digesting a 3 per cent. starch mixture. Starch as a food is better borne and better tolerated by the infant than was formerly believed. Current (Northwest Med., Oct., 1920).

In most cases colic is due not only to too much fat but usually to too great a quantity of breast milk. One can reduce the quantity of breast milk, but it is well known that many

cases of colic do not respond to these simple methods. The following treatment proved successful: Morning and evening the child is given about 5 c.c. ($1\frac{1}{4}$ drams) of the liquid culture of active **lactic acid bacilli**, and each breast feeding is preceded with 1 Gm. (15 grains) of **powdered casein**. If it is impossible to obtain the powdered casein, one may carefully skim milk and take the **curd of the milk**. The quantity of curd to be used before each nursing is approximately that obtained from an ounce of skimmed milk. Ready coöperation of the mother is usually obtained when she learns that the treatment consists in giving the child some extra food. The treatment does not bring results at once, only after a week or 10 days, but the benefit begins to appear in 24 to 48 hours.

Another type of colic which is rather frequently encountered is that due to a deficient quantity of breast milk. If the infant has colic under these circumstances, the best food for supplementing it will prove to be **albumin milk**. Grulee (Jour. Amer. Med. Assoc., Dec. 18, 1920).

Habitual crying in breast-fed babies at a particular time each day—usually late afternoon and at night—is a pathognomonic symptom of hunger. The preternaturally smart, wide-awake baby is hungry. Three-months colic is also primarily hunger. Starvation, indigestion, and milk imbalance due to the mother's worry may cause true colic to supervene, but these right themselves if the baby's cries are hushed. **Supplemental and complementary feeding** is the remedy, given only with a cup and spoon. E. Rosamond (Trans. Soc. Med. Assoc.; Med. Rec., Jan. 15, 1921).

Stools.—That the nursing is improper may be shown either by constipation, with dry, light-colored or greenish stools of foul odor, or by diarrhea, with thin yellow or green stools, four to ten a day, which contain curds and, after a time, mucus.

Sleep and Disposition.—Sleeplessness, restlessness, and fretfulness are generally due to hunger or indigestion.

During the latter part of lactation the signs of inadequate nursing, in addition to those already given, are: stationary weight or actual loss, delayed dentition, delayed closure of the fontanelle, flabby muscles with inability to sit or stand at the proper age, and anemia. There may be also symptoms of malnutrition or of incipient rickets.

The presence of all or of any one of these symptoms is enough to arouse suspicion, and the physician must determine whether the quantity or the quality of the breast-milk is at fault or both. This can be made out by the method already described, and then the proper treatment instituted as indicated below.

MEANS OF IMPROVING BREAST-MILK WHEN NURSINGS ARE NOT THRIVING.—

When the milk is poor an important consideration is whether this quality is due to a temporary or accidental cause—as severe labor or one of the complications of labor—or to a constitutional cause. In the former case much may be done; in the latter, almost nothing. If the milk is poor and scanty, the woman's general condition should be improved by giving a diet consisting largely of meat, eggs, milk, gruels, and liquids in abundance; a good extract of malt may be added. Out-of-door exercise, plenty of sleep, and freedom from anxiety are especially important. Gentle massage of the breasts often gives gratifying results, but it is imperative that the breasts and the hands of the operator be scrupulously cleansed before it is begun. (See AGALACTIA under MAMMARY GLAND, vol. VI.)

When the milk is excessively rich, and the quantity abundant, a reduction in the amount of meat, and the abstention from malted or alcoholic drinks, with active outdoor exercise, will usually reduce the ingredients to the standard. This condition of the milk frequently obtains with wet-nurses.

In conclusion, if the milk is very rich, the proportions can usually be reduced, by careful observation of the measures recommended, to a point where the infant is able to digest it. If the milk is poor and scanty there is less probability of success. In either case, *if, after two or three weeks' trial, the milk has not improved,* and the child continues to suffer from indigestion, it is better to wean at once, or secure another nurse, rather than persist longer in the attempt.

WET-NURSING.—To secure a good wet-nurse is difficult, and there is no certainty that her milk will agree with the foster-child. The ideal wet-nurse is a healthy, young, placid, unmarried primipara that lost her infant shortly after birth; she should be phlegmatic in temperament, and of sufficient intelligence to nurse the baby regularly. The actual wet-nurse in this country is usually a buxom married multipara whose baby and home-cares keep her constantly dissatisfied with her temporary occupation.

One may closely approximate the ideal by selecting a healthy woman between 20 and 30, not necessarily a primipara, who has a thriving infant. Women with syphilis, tuberculosis, chorea, or epilepsy should be excluded, both by their history and by examination of the hair, throat, skin, lymph-nodes, and chest. The Wassermann test should be made in every instance

and the woman rejected if it is found to be positive by a reliable laboratory. The breasts should be well-developed glands that become hard with milk within three hours after a nursing; the nipples should be of good size, well formed, and free from fissures.

The wet-nurse's child should, of course, be carefully examined. In regard to the age of the child, it need not correspond very closely to that of the foster-child. In general, the milk should not be more than six weeks old for a child of one to three weeks; if the foster-child is over six weeks, the milk may be from two to six months old.

It is more important that the woman be healthy, her baby thriving, and her milk free-flowing. In general it is safest to take a wet-nurse whose baby is at least three months old, so as the more surely to exclude hereditary syphilis.

An important caution is to see that the nurse is not overfed, and that she takes regular active out-of-door exercise; otherwise the milk is apt to become too rich.

To prevent the high death rate in the best infant hospitals, due to the chronic malnutrition of the cases brought, the method used at the Children's Memorial Hospital, where two or three wet-nurses have been employed to furnish breast-feeding for infants, is to be strongly recommended.

Each nurse brings her own baby, and both are examined before engagement, that of the mother including the Wassermann test. The nurse is paid \$30 per month, with board and room, and, in addition to her duties as foster mother, does general work about the ward. The mother nurses her own baby every four hours, usually on one breast. The other is pumped at the alternate four

hours, the mammæ being thus stimulated to activity every two hours. The milk is fed by bottle to the ward babies, none of them being put to the breast for fear of infecting the woman, for example, with latent syphilis.

The method has the further advantage of allowing definite amounts of breast-milk to a given baby. F. S. Churchill (*Jour. Amer. Med. Assoc.*, Nov. 21, 1914).

One of the most important factors is the diet of the nursing woman. A number of diets were used, with these results:

A diet to be properly efficient must cause increased growth of offspring without impairing the tissues of the mother.

Diets containing from 2600 to 2900 calories in 24 hours produced better results than diets containing from 3400 to 3700 calories. It is of no avail to overfeed in hope of maintaining or increasing the milk supply. Diets containing 2000 calories or less cannot protect maternal tissues and at the same time produce sufficient milk.

A nutritive ration of less than 1:6 gave best results. Hoobler (*Jour. Amer. Med. Assoc.*, Aug. 11, 1917).

WEANING AND MIXED FEEDING.—With few women among the better classes can nursing be continued beyond the ninth, and generally not beyond the sixth or seventh month, without exhausting the mother or partially starving the child.

When Should Weaning be Begun?

—Stationary weight or actual loss, the child being otherwise well, means insufficient food. After the sixth or seventh month this indicates weaning. Anemia, as shown by pallor of the lips, or by blood examination, is another such indication. Before the sixth month the attempt may be made to improve the milk by the means

already suggested, using in the mean time supplemental bottle feedings two or three times a day. If the milk does not become normal in amount, it may still satisfy the infant at three or four nursings daily, the bottle being given in place of the other nursings:

This method of "mixed feeding" may be very profitably continued as long as the child thrives: it is much better for the child than complete weaning. If the nurse cannot satisfy the baby at least twice a day, the child would best be weaned. Speaking generally, weaning should be begun at the ninth or tenth month; but even then the weekly weighing is the safest guide.

Method of Weaning.—At whatever time begun, the process should be gradual, if possible, lest the mother have trouble with her breasts, and the child with its stomach and bowels. At first a bottle should be given twice a day: if the food causes no indigestion the number of feedings and the quantity may be gradually increased up to the full quota for the child's age, according to the table below, under "Modification of Milk for Healthy Infants During the First Year," page 127.

As to the formulæ to be used, if the baby is under 4 months old, the food for the first few days should be as weak as that for a newborn child; if from 4 to 9 months, the formula should be at first that for a month-old child; and, if from 9 to 12 months, that for a 3-month child. The important point is always to start with a sufficient quantity of very dilute food, and afterward increase the proportions as rapidly as the child can assimilate them.

The child should be weaned when at least a year old. If the child is thriving and has already shown evidence of digesting cows' milk, it may be weaned at the tenth month, provided that this does not coincide with the warm months. Weaning should not occur either immediately before or after the warm months; hence, it should not occur in May, June, July, August or September. Prolonged lactation is bad, resulting in delayed dentition and maldevelopment of the bones. Gradual weaning should be practised. During the first year the infant should receive nothing but milk. The addition of soups, legumes, wine, etc., to its diet is to expose it to the danger of rickets. At the period of weaning the mother should expose herself to fatigue as little as possible; the breasts should be included in a binder with cotton and may be gently rubbed, morning and evening, with warm sweet-almond oil. The use of purgatives is not indispensable; the mother should diminish the quantity of fluids in her diet. During the second year, until the appearance of the twentieth tooth, the best nourishment for the child is found in milk, bread, and eggs. Under bread is included bread in all its forms, as well as the cereals. A. Pinard (*Rev. Prat. d'Obstet., et de Pédiat.*, Dec., 1904).

In 10 cases of a chronic nutritional disorder after weaning, termed by Herter in older children "infantilism from chronic undernutrition," 5 were so severely affected that 1 died; the others presented disturbances in a milder form. It is a congenital defective or feeble state of the digestive apparatus. So long as the child is nursing it is able to cope with the digestive demands, but when it is weaned the insufficiency of the digestive apparatus is soon revealed. In some cases **breast-milk** was the only anchor that held; one boy of 5 was given a wet-nurse and was tided along on breast-milk until past 7. He is now, twenty years later, strong and hearty. This was the severest

case with a favorable outcome. In all the cases a neuropathic or other morbid inheritance was evident. O. Heubner (*Jahrbuch f. Kinderheilk.*, Dec., 1909).

ARTIFICIAL, OR SUBSTITUTE, FEEDING.—In order that an infant may properly thrive on an artificial food, certain fundamental principles must be complied with, viz.:—

The food must contain the same nutritive ingredients as breast-milk, and in about the same proportions.

As nearly as possible the elements of the food should resemble those of breast-milk, both in chemical composition and in their behavior to the digestive fluids.

There is no perfect substitute for mothers' milk. Diluted cows' milk is the best substitute there is, but the tendency is to make the dilution too complicated. Sterilized milk is dangerous. A child may gain in weight under its use, but soon it will become anemic, constipated, and perhaps rachitic. Milk depots should not be managed by nurses and laymen, but by a physician who knows the supreme value of breast-feeding. Burnet (*Pract.*, April, 1908).

In accordance with these principles, cows' milk is selected, because it furnishes the elements required, although not in proportions best suited to the infant's needs.

Scientific infant feeding consists in doing what is right at the time, for the particular infant. It is impossible to state in a book what shall be done under all conditions, for the conditions are seldom exactly alike in different cases. For example, at one time it may be highly scientific to pasteurize food, and at another time just as scientific to add certain types of bacteria to the food. Here there is no contradiction. Each procedure has its place and in its place

is scientific. Pisek (*N. Y. State Jour. of Med.*, Jan., 1914).

The latest scientific studies in nutrition emphasize great simplicity in the preparation of artificial food for infants, if the biological side is properly emphasized. Success will result when attempts to solve feeding problems by intricate chemical manipulation of food cease. It is more practical to employ scientifically the biological factor. The principal ingredient, **cows' milk**, if scientifically produced and handled, may be simply **diluted in right proportion to the age**, it being kept in mind that none of its constituents, protein, fats, carbohydrates, must be long reduced below what is known to be the average content in human milk. H. D. Chapin (*Jour. Amer. Med. Assoc.*, Oct. 3, 1914).

·COWS' MILK.—Differences between Cows' Milk and Breast-milk.—The composition of good breast-milk and cows' milk is given in the table:—

Constituents.	Woman's Milk, Average.	Cows' Milk, Average.
Fat	4.00 per cent.	4.00 per cent.
Sugar	7.00 per cent.	4.50 per cent.
Proteids	1.25 per cent.	3.50 per cent.
Salts	0.20 per cent.	0.70 per cent.
Water	87.55 per cent.	87.75 per cent.

It appears, therefore, that cows' milk contains a large excess of proteids and of salts, but too little sugar; the fat is present in about the same proportion in both. Moreover, cows' milk is acid in reaction and contains numerous bacteria.

Fat.—The average amount of the fat of cows' milk which a healthy infant can digest varies from 2.0 to 4.5 per cent. Beginning with 1.5 per cent., or lower, in the early days of life, the amount may be increased to 3.0 per cent. at one month, and 4.0 per cent. at five or six months.

Sugar.—The sugar in both kinds of milk is simply lactose in solution;

but the proportion in cows' milk is only about two-thirds that in breast-milk.

Proteids.—The proteids show the greatest differences, both in quantity and in character. A good average breast-milk contains nearly 1.5 per cent. of proteids, of which about one-third is casein and the other two-thirds the soluble and easily digestible lactalbumin. Cows' milk contains nearly 4 per cent. of proteids, of which four-fifths is casein, while only about one-fifth is lactalbumin. Stated in another way, breast-milk contains about 1 per cent. lactalbumin and 0.5 per cent. of casein, while cows' milk contains only about 0.8 per cent. of lactalbumin, but 3.2 per cent. of casein.

Inorganic Salts.—The salts are about three and a half times more abundant in cows' milk.

Reaction.—The reaction of cows' milk is acid, while that of human milk is more nearly alkaline, rarely neutral.

Bacteria.—Breast-milk is practically sterile, while cows' milk always contains germs, some of which may be pathogenic. A large proportion of diarrheal diseases are believed to depend upon the saprophytic bacteria; and typhoid, cholera, diphtheria, tuberculosis, and scarlatina may be transmitted by cows' milk.

Modification of Cows' Milk.—Because of the differences noted above between breast-milk and cows' milk, certain modifications must be made to adapt cows' milk to the digestion of the average infant.

PROTEIDS.—A reduction in the proportion of the proteids can be effected by simply diluting the milk.

SUGAR.—Sufficient sugar must be added to bring the proportion in the

food up to between 5 and 7 per cent. Good milk-sugar is preferable in the great majority of cases, but where it is not obtainable, or where it causes indigestion, granulated sugar or some of the preparations of maltose or of maltose and dextrin may be used, and with many infants answers even better. The quantity of cane-sugar used, however, should be only about half the amount of milk-sugar required, because, if added in full quantity, it makes the food too sweet.

FAT.—Diluting the milk to reduce the proteids diminishes the proportion of fat also; so that cream must be added, or specially rich milk used, in order to have the fat in proper amount.

INORGANIC SALTS.—The dilution required for the proteids will reduce the salts to about the proper proportion. **Lime-water** is usually added in a proportion of from one-twentieth to one-tenth of the total quantity of the food.

The antiscorbutic vitamine is very sensitive to an alkaline reaction and deteriorates rapidly in milk rendered alkaline. The frequent occurrence of infantile scurvy after the use of malt soup preparations is due to the potassium carbonate it contains. Experiments on animals support these conclusions. Potassium citrate should be used by the manufacturers of proprietary foods instead of the alkaline potassium carbonate. A. F. Hess (Trans. Amer. Med. Assoc.; N. Y. Med. Jour., June 21, 1919).

STERILIZATION AND PASTEURIZATION OF MILK.—The purposes of "sterilizing" milk are: 1. The destruction of pathogenic bacteria which may have gained entrance. These are the germs of typhoid, diphtheria, cholera, tuberculosis, the streptococci of septic sore throat, and those which produce diarrheal dis-

eases. The milk may receive this contamination from disease in the cow, from the milker's hands, or from the water in which the pails, cans, and jars are washed. The close connection which exists between the diarrheal diseases of summer and a contaminated milk-supply must never be lost sight of. The fact that these pathogenic germs are so frequently present, together with the fact that milk in cities is twenty-four to forty-eight hours old, and must often be kept without ice, makes some means of destroying the germs desirable or imperative.

2. The destruction of the ordinary germs of lactic-acid fermentation is desirable in order that the milk may be kept safely for a longer time.

"Sterilizing" the milk at a high temperature is the method first proposed for destroying the germs. This so-called "sterilization" means heating it to a temperature of 212° F. (100° C.) for sixty to ninety minutes. This kills all the germs not in spore form, and such milk will keep for a week at ordinary room temperatures. New germs, however, may develop.

Sterilizing at a low temperature, or pasteurization, is the second and preferable method. By pasteurizing is meant heating the milk for half an hour or more at a temperature of from 155° to 170° F. (68.3° to 76.6° C.). This is sufficient to destroy the pathogenic germs, though not their spores; such milk will keep on ice for only two or three days.

[Freeman's pasteurizer is the simplest apparatus for sterilizing at low temperatures. It may be obtained from most large drug-stores, or from James Dougherty, No. 411 West Fifty-ninth Street, New York. L. EMMETT HOLT and L. E. LA FÉTRA.]

High-temperature sterilization would seem to be the ideal method; but it is open to certain objections. In the first place it changes the taste to that of boiled milk, which many children do not like. It renders the milk constipating and the nutritive properties of the milk are somewhat impaired; for it appears now beyond dispute that the use of sterilized milk as the sole diet for a long time is not infrequently followed by the production of scurvy.

Pasteurization does not change the taste nor make the milk constipating. Whether pasteurizing the milk changes it so that scurvy may result is not determined; certainly the danger is so slight that it may be disregarded.

Pasteurization is recommended in all cases during the warm months. Sterilization is advised only for use among the very poor, in cities during very hot weather, in any place where ice is not obtainable, and for transportation on long journeys. In cool weather, with a fresh, clean milk-supply and plenty of ice, neither method is necessary.

So many dangers of gastrointestinal infection are removed by sterilization and pasteurization that they are to be regarded as valuable safeguards.

It is impossible to determine from the evidence at present available whether or not babies fed continuously on **pasteurized milk** thrive as well as those fed on raw milk, or whether or not the continuous use of pasteurized milk predisposes to the development of the diseases of nutrition. There is sufficient evidence to show, however, that if the continuous use of pasteurized milk is injurious to babies, its possibilities for harm are much less than those of bacteria. All but the cleanest milk

should, therefore, be pasteurized before it is given to infants. J. L. Morse (Boston Med. and Surg. Jour., Oct. 10, 1912).

MODIFICATION OF MILK FOR HEALTHY INFANTS DURING THE FIRST YEAR.—Not all infants, even if normal and healthy, can be fed in the same way. The problem, therefore, is to make a food in which the quantity of each ingredient—fat, sugar, and proteid—shall be known, and in which, also, these quantities can be separately varied so as to suit the digestive capacity and peculiarities of the individual child.

The writer found on record 23 cases of an actual idiosyncrasy to cow's milk, and adds 3 cases to the list from his personal experience. In one of Finkelstein's cases the resulting disturbances proved fatal, but in all the others the symptoms subsided on suspension of cow's milk and feeding with small amounts of **breast-milk**, generally drawn and given to the infants with a spoon. In Finkelstein's fatal case the fever kept up for nine days, terminating at 106° F. The child looked collapsed, the skin was pale and cool or cyanotic. The respiration shallow and rapid. Gastrointestinal disturbances were noted in nearly every case and in 2 cases an eruption occurred during or directly after the milk feeding. The infants ranged from 9 to 42 weeks old. The idiosyncrasy was finally conquered in all but one case by cautious administration of **very small amounts of milk**, the exception being a girl, now 15, who is still unable to take even the least amount of milk. Zybell (Med. Klinik, July 24, 1910).

To wean a baby it is best to begin with a cows' milk mixture considerably weaker than would be given a healthy baby of the same age previously raised on a bottle. A fair average is to start at about $\frac{1}{2}$ the strength of what would ordinarily be given to a healthy infant of the same

age as the baby to be weaned. If the child can digest this, the formula can be increased cautiously. It is wiser, as a rule, not to wean the baby during the hot summer months, thus avoiding gastrointestinal disturbances, unless one goes to a cool climate. Graham (Penn. Med. Jour., Aug. 1919).

The writer opposes feeding newborn babes $\frac{1}{3}$ milk to $\frac{2}{3}$ water. Such dilutions are too weak. For the last 20 years he has recommended a 50 per cent. dilution of whole milk for the newborn, and has never seen any bad results. E. Moro (Monats. f. Kinderheilk., Nov., 1920).

Milk Laboratories.—In several cities of the United States, and in London, there have been established milk laboratories that put up modified milk in accordance with the prescription of the attending physician. Any combination may be ordered, and the food will be pasteurized or peptonized if desired.

Moreover, artificial buttermilk, fermented by the Bulgarian bacillus, and also Finkelstein's "Eiweiss milch," may be obtained from some of these Walker-Gordon Laboratories. For the great mass of our population, however, these laboratories are not available, so that the milk must be modified at home.

Home Modification of Milk.—Various methods have been suggested for home modification, all somewhat complex. At present it cannot be said that the ideal method has been devised. All are only approximate in their results, but they are highly satisfactory, if the details are carefully carried out.

For the physician the so-called "percentage method" of milk modification is the best mode of expressing the exact quantities of each ingredient used, and it is of great advantage for the physician not only to know the percentages being used, but also to

know the total number of caloric units in a day's feedings. If one uses milk of known fat percentage, it is a simple matter to calculate the percentages of the fat and proteid. The percentage of carbohydrates will depend upon the amount of sugar, starch, dextrin or other carbohydrate added to the milk. The following tables will serve as a convenient guide for the calculation of the percentages of the composition of milk mixtures and also for the determination of the caloric value of the food:—

To obtain 3% milk, use remainder, after
skimming off 3 ounces.

To obtain 2% milk, use remainder, after
skimming off 5 ounces.

To obtain 1% milk, use remainder, after
skimming off 8 ounces.

With Formulas I to V, enough sugar should be added to raise the amount to 5 per cent.

With Formulas VI to XV, enough sugar should be added to raise the amount to 6 per cent.

1 ounce milk-sugar by weight in 20-ounce mixture adds 5.00 per cent.

1 ounce milk-sugar by volume in 20-ounce mixture adds about 3.00 per cent.

1 even tablespoonful	in 20-ounce
mixture adds	1.75 per cent.

TABLE I.—FORMULAS OBTAINED FROM MILK CONTAINING DIFFERENT PERCENTAGES OF FAT.

		A 7 % Milk.	B 6 %	C 5 %	D 4 %	E 3 %	F 2 %	G 1 %		Per cent.		Per cent.
I	1 ounce in 20 has Fat	0.35	0.30	0.25	0.20	0.15	0.10	0.05	with Protein	0.175	Sugar	0.225
II	2 ounces in 20 have Fat	0.70	0.60	0.50	0.40	0.30	0.20	0.10	with Protein	0.35	Sugar	0.45
III	3 ounces in 20 have Fat	1.05	0.90	0.75	0.60	0.45	0.30	0.15	with Protein	0.50	Sugar	0.65
IV	4 ounces in 20 have Fat	1.40	1.20	1.00	0.80	0.60	0.40	0.20	with Protein	0.70	Sugar	0.90
V	5 ounces in 20 have Fat	1.75	1.50	1.25	1.00	0.75	0.50	0.25	with Protein	0.85	Sugar	1.10
VI	6 ounces in 20 have Fat	2.10	1.80	1.50	1.20	0.90	0.60	0.30	with Protein	1.05	Sugar	1.35
VII	7 ounces in 20 have Fat	2.45	2.10	1.75	1.40	1.05	0.70	0.35	with Protein	1.20	Sugar	1.55
VIII	8 ounces in 20 have Fat	2.80	2.40	2.00	1.60	1.20	0.80	0.40	with Protein	1.40	Sugar	1.80
IX	9 ounces in 20 have Fat	3.05	2.70	2.25	1.80	1.35	0.90	0.45	with Protein	1.60	Sugar	2.00
X	10 ounces in 20 have Fat	3.50	3.00	2.50	2.00	1.50	1.00	0.50	with Protein	1.75	Sugar	2.25
XI	11 ounces in 20 have Fat	3.80	3.30	2.75	2.20	1.65	1.10	0.55	with Protein	1.90	Sugar	2.45
XII	12 ounces in 20 have Fat	.....	3.60	3.00	2.40	1.80	1.20	0.60	with Protein	2.10	Sugar	2.70
XIII	13 ounces in 20 have Fat	.....	3.90	3.25	2.60	1.95	1.30	0.65	with Protein	2.25	Sugar	2.90
XIV	14 ounces in 20 have Fat	.....	....	3.50	2.80	2.10	1.40	0.70	with Protein	2.40	Sugar	3.15
XV	15 ounces in 20 have Fat	.....	....	....	3.00	2.25	1.50	0.75	with Protein	2.60	Sugar	3.35

TABLE II.—TO OBTAIN DEFINITE FAT PERCENTAGES.

From 4 per cent. Milk.

To obtain 7% milk, use upper 16 ounces.

To obtain 6% milk, use upper 20 ounces.

To obtain 5% milk, use upper 24 ounces.

To obtain 4% milk, use all.

To obtain 3% milk, use remainder after
skimming off 2 ounces.

To obtain 2% milk, use remainder after
skimming off 4 ounces.

To obtain 1% milk, use remainder after
skimming off 8 ounces.

From 5 per cent. Milk.

To obtain 7% milk, use upper 20 ounces.

To obtain 6% milk, use upper 24 ounces.

To obtain 5% milk, use all (shake the bottle).

To obtain 4% milk, use remainder, after
skimming off 2 ounces.

TABLE III.—CALORIC VALUES.

1 ounce 7 per cent. milk	27.5
1 ounce 6 per cent. milk	25.0
1 ounce 5 per cent. milk	22.5
1 ounce 4 per cent. milk	20.0
1 ounce 3 per cent. milk	17.5
1 ounce 2 per cent. milk	15.0
1 ounce 1 per cent. milk	12.5
1 ounce fat-free milk	10.0
1 ounce whey	10.0
1 ounce milk-sugar by weight	116.0
1 ounce milk-sugar by volume	72.0
1 even tablespoonful of milk-sugar ...	44.0
1 ounce barley-flour by weight	100.0
1 ounce barley-water (1 tablespoonful to a pint)	2.0
1 ounce malt-soup extract	80.0
1 ounce condensed milk	132.0
1 ounce olive oil by volume	245.0

Home Modification by Using Standard Cream and Milk Mixtures.—This

method is that which we have found the simplest, and, therefore, the most satisfactory. The materials needed for the ordinary modifications of milk are the following:—

I. MILK.—The cleanest milk possible should be procured. Wherever certified milk is obtainable it should be used in preference to any other kind, and if one has a choice between ordinary milk and that from Jersey or Alderney cattle, the less rich milk should be preferred, not only because the fat-globules are larger in Jersey milk, but also because the composition is more variable than that from Holstein or Grade cows. In summer the milk should be pasteurized or sterilized, preferably after the formula is entirely made up.

In order to produce definite results by diluting milk, it is necessary to know, approximately at least, the average composition of the milk or the cream-milk mixture which is to be diluted. For practical purposes, mixed herd-milk may be considered as containing 4 per cent. of fat, 4.5 per cent. of sugar, and 4 per cent. of proteid. In Alderney and Jersey milk the fat is much higher. Cream—if obtained by the gravity method, the milk standing twelve hours—contains about 16 per cent. of fat. Light or thin centrifugal cream has about 20 per cent. of fat, while the heavy centrifugal cream contains from 30 to 40 per cent. of fat. Top-milk is the upper portion of the milk with the cream, taken after the milk has stood a definite number of hours. If, for example, one quart of milk stands on ice for twelve hours, the cream from it contains about 16 per cent. of fat; if it stands six hours, the upper 6 ounces contain about 12 per cent. of

fat; if for three hours, the upper 10 ounces has about 8 per cent. of fat. In top-milk thus removed the sugar may be considered as 4 per cent. and the proteids as nearly 4 per cent. In this way one may obtain for dilution cream-milk mixtures containing any of the required percentages of fat.

II. MILK-SUGAR OR OTHER SUGARS.—Care should be taken to procure a thoroughly reliable preparation of milk-sugar, since much of that on the market contains impurities. In place of milk-sugar, granulated sugar, dextri-maltose, Loefflund's Malt-soup Extract or some other preparation of malt may be employed. Cane-sugar is less laxative than milk-sugar, but must be used in smaller quantity lest it make the food too sweet. The maltose preparations are somewhat more easily absorbed than the sugars and can be used in the same amount as milk-sugar. The dextri-maltose is less laxative than the other malt preparations and is less apt to disturb the stomach.

III. BARLEY-WATER, or some other carbohydrate diluent, is usually employed, after the first few weeks. The barley-water can most easily be made by using the flour instead of the grains, Robinson's barley-flour or that of the Cereo Company being most generally used. In place of barley-flour, oat-flour or Imperial Granum may be employed; the former has the advantage of being somewhat more laxative, the latter somewhat less laxative than the barley-flour.

IV. LIME-WATER OR MILK OF MAGNESIA.—Fresh preparations should be secured. The lime-water not only acts as an acid, but as a gastric stimulant. The milk of magnesia has the advantage of being laxative.

PREPARATION OF THE FOOD FOR HEALTHY INFANTS.—

Whereas it is impossible to give simple rules by which every infant can be successfully fed, still experience shows that average healthy infants under 1 year old may be fed according to a schedule arranged for certain periods. The schedule applies to healthy infants of average weight, under average conditions, and is meant to serve as a general guide, not to be blindly followed, for varying circumstances will modify any plan of feeding.

Either whole-milk or top-milk may be used for making up the milk formulæ. If top-milk is used it should never be stronger than the upper half of the bottle, the top 16 ounces being removed by use of the ounce dipper. For healthy infants with a good digestion the use of milk mixtures made from top-milk is advantageous and the amount of fat in such mixtures will seldom cause any indigestion. For infants with feeble digestions, however, or for those that have recently recovered from diarrhea, top-milk mixtures are not advisable; instead, the formulæ should be made from whole-milk or even from skimmed milk. In general it may be said that during the first three or four months the top-mixtures should be used. After the fourth or fifth month the food should be made up from whole-milk.

As a general guide it may be stated that during the first week of life the baby will need from 3 to 5 ounces of milk or top-milk. This may be diluted with 8 ounces of water and 1 ounce of lime-water, and to it should be added 1 to 2 even tablespoonfuls of milk-sugar. The baby should take

from 1 to 2 ounces of such a formula eight times in twenty-four hours.

At one month the baby will need about 10 ounces of milk or top-milk. This may be diluted with 16 ounces of water or barley-water and 2 ounces of lime-water; 3 even tablespoonfuls of milk-sugar should be added and the baby may be offered from 3 to 4 ounces seven times in twenty-four hours.

At three months the baby will need about 16 ounces of milk or top-milk to which is added 14 ounces of cereal diluent, 2 ounces of lime-water, and 4 even tablespoonfuls of milk-sugar. The baby may take between 4 and 5 ounces six or seven times in twenty-four hours.

At six months the baby will need from 18 to 21 ounces of mixed milk to which are added 18 ounces of a cereal diluent, 5 or 6 even tablespoonfuls of milk-sugar, and 2 ounces of lime-water. The baby may take between 6 and 7 ounces six times in the twenty-four hours. At eight months the baby will take about the same quantity of food, but should have the intervals between the feedings changed to four hours, taking about 8 ounces at each feeding five times in the twenty-four hours. If the child is large and well developed and has a good digestion, a small amount of thoroughly cooked cereal, such as cream of wheat or farina, may be given at two of the feedings; and at nine months part or the whole of a soft-cooked egg may be given at the midday feeding in addition to the bottle. The baby should be encouraged to chew on a crust of bread or zwieback in order to learn how to swallow solid food. At nine months the formula may be three-fourths

milk and one-fourth of thick cereal gruel, and as the cereal given by itself is increased, the amount used in the formula may be diminished so that by ten or twelve months the baby should be taking whole-milk.

It is important that all babies should be given water between their feedings, and from the third month on they should be encouraged to drink water, at first from the bottle and, after the ninth month, from a cup. Frequently when a baby cries between feedings it is because he is thirsty, and this is especially true in summer or when the baby is kept in a very warm room. The practice of offering water between the feedings lessens the liability of indigestion from overfeeding.

Bottles and Nipples.—Graduated cylindrical bottles, with wide mouths, are generally preferred, being easily cleansed. The best nipples are those of plain black rubber which slip over the neck of the bottle. On no account should a nipple with a long rubber tube be used. The hole in the nipple should not be large enough to let the milk run in a stream when the bottle is inverted.

Bottles should always be boiled before the food is put into them and both bottles and nipples thoroughly washed after use. Nipples should be kept in a borax or boric acid solution.

RULES FOR ARTIFICIAL FEEDING.—The rules as to frequency and regularity of feedings are more important with bottle-fed than with nursing babies. The table given below will serve as a guide. Just before feeding the food is heated to body temperature by placing the bottle in a vessel of hot water; a bottle should not be warmed over for a second feeding. Twenty minutes is long enough for a feeding; no child should be allowed to sleep with the nipple in its mouth.

The baby should be held up when fed and also for a few minutes immediately after finishing his bottle, in order to permit the swallowed air and gas to escape from the stomach. Often a baby is more comfortable after feeding if placed on the stomach or in a semireclining position instead of lying flat on the back.

Schedule for feeding healthy infants during the first year appears below.

The Use of Other Substances than Milk during the First Year.—Besides the ingredients of modified milk, the only other foods to be given during the first year are beef-juice, the fruit-juices, well-cooked cereal gruels, and, during the latter part of the year, soft-cooked egg.

BEEF-JUICE may be added to the diet at about the tenth month. At

Age.	No. of Feedings in 24 Hours.	Interval Between Meals by Day.	Night-feedings 10 P.M. to 7 A.M.).	Quantity for One Feeding.	Quantity for 24 Hours.
Third to seventh day	8	2½ hrs.	2	1 to 1½ oz.	10 to 15 oz.
Second and third weeks	8	2½ hrs.	2	1½ to 3 oz.	15 to 24 oz.
Fourth and fifth weeks	7	3 hrs.	1	2½ to 4 oz.	22 to 28 oz.
Sixth week to third month ...	7	3 hrs.	1	3 to 5½ oz.	24 to 35 oz.
Third to fifth month	7	3 hrs.	1	4 to 6½ oz.	28 to 42 oz.
Fifth to eighth month	6	3½ hrs.	0	5½ to 7 oz.	33 to 42 oz.
Eighth to twelfth month	5	4 hrs.	0	7½ to 9 oz.	37 to 45 oz.

first $\frac{1}{2}$ ounce is given, either alone or with the milk; the amount may be increased up to 2 or 3 ounces daily, given at two or three feedings.

FRUIT-JUICES.—Strained orange-juice is the most useful of the fruit-juices, and may be added by the seventh or eighth month. It is best given about an hour before the feeding, $\frac{1}{2}$ to 1 or 2 ounces at a time. The fruit-juices are particularly useful in constipation, especially prune-juice.

INDICATIONS FOR SPECIAL MODIFICATIONS.—**I. Flatulence and Habitual Colic.**—These symptoms are almost invariably due to overfeeding, the food being too strong or given in too large quantity, or most often because the baby is fed at too frequent intervals.

II. Curds in the Stools.—If soft and small, they have no practical significance; if they are soft, large, and yellow, they are probably due to undigested fat, and a milk less rich in cream, or skimmed milk, should be used. If they are hard, glistening, and yellowish or white, elastic, and showing a granular surface when broken up, they are due to undigested casein. The difficulty may be remedied either by **boiling the milk** or by **lessening the quantity of milk in the formula**.

III. Vomiting.—If shortly after feeding, the regurgitation is generally to be remedied by diminishing the quantity or the frequency of the feedings, or both. If the vomiting occurs an hour or so after a feeding it is often due to too much fat, and the **cream should be reduced**.

In some conditions of slow stomach digestion it is better to **feed every three or four hours**, instead of every two and a half or three hours.

IV. Loss of Appetite.—The indication is to **make the intervals of feeding longer, the quantity smaller, and the food more dilute**; this applies particularly to the fat. The symptom indicates feeble digestion, for the time being, and can best be treated by greatly reducing the amount of work required.

V. Constipation.—This is a frequent symptom, and is always hard to control. The difficulty often is that there is insufficient residue, and this is to be overcome by **increasing the proportions of all the ingredients**. A second cause is too small a percentage of fat; but it is seldom advisable to increase the fat above 4 per cent., because of constipation.

Too often the constipation depends on bad habits rather than on anything wrong with the food; so that **early training** is of very great importance.

The addition of a **larger amount of milk-sugar**, if it does not cause vomiting, may overcome the constipation. A better plan is to use **oatmeal-water** as a **diluent**, or to substitute one of the **malted carbohydrates** for part or all of the milk-sugar.

VI. Diarrhea.—A diarrhea which has as a cause simply a wrong proportion in the food is very rare. Frequent almost normal movements, however, may be due to too high fat. Generally the diarrhea is due to acute or subacute indigestion in the intestines. **Withholding all milk food for twenty-four hours** and the use of **barley-water** or **Imperial Granum water** is advisable. Then, either **Eiweiss milk** or a **boiled skimmed-milk mixture** may be used, the strength of the formula being low at first, and gradually increased each

day as the digestive symptoms improve.

VII. Failure to Gain in Weight.—This symptom, in a child with a good appetite and good digestion, means insufficient nourishment. The quantity of the food should first be increased, and then the proportions of fat and proteids gradually raised, so as not to disturb the digestion. Frequently the addition of some cereal or of beef-juice and egg to the dietary, with reduction of the milk, will prove efficacious.

L. EMMETT HOLT

AND

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NUTMEG (*Myristica*, U. S. P.) is the kernel of the ripe seed of *Myristica fragrans*, family Myristicaceæ. It is obtained from a small, evergreen, diœcious tree, a native of the Molucca Islands, but is now obtained wholly from trees cultivated in various tropical countries, which bear a fleshy fruit resembling a peach. At maturity the pericarp splits into halves, disclosing the solitary seed covered in part by the scarlet aril which, removed and dried, constitutes macis or mace. Nutmeg contains 2 to 8 per cent. of a volatile oil (*oleum myristicæ*), 25 to 30 per cent. of fixed oil, proteids, gum and starch.

PREPARATIONS AND DOSES.—

The official preparations are:—

Myristica, U. S. P. (nutmeg). Dose, 5 to 10 grains (0.30 to 0.60 Gm.).

Fluidextractum aromaticum, U. S. P. (aromatic fluidextract) contains 15 per cent. nutmeg. Dose, 10 to 30 minims (0.60 to 2.0 c.c.).

Oleum myristicæ, U. S. P. (volatile oil of nutmeg). Dose, 1 to 3 minims (0.05 to 0.20 c.c.).

Pulvis aromaticus, U. S. P. (aromatic powder), contains 15 per cent. nutmeg, 15 per cent. cardamom, ginger and cinnamon each 35 per cent. Dose, 5 to 15 grains (0.30 to 1 Gm.).

Myristica kino is obtained from the nut-

meg grown in India. It resembles very closely the Malabar product and contains about 30 per cent. of kinotannic acid. Dose, 10 to 20 grains (0.60 to 1.3 Gm.).

PHYSIOLOGICAL ACTION.—Nutmeg possesses aromatic and carminative properties and considerable narcotic power; in overdose it causes stupor and delirium.

POISONING BY NUTMEG.—Gillespie, Waugh, and others have reported cases where large doses of this drug have produced frontal headache, vertigo, free diaphoresis and urination, narcosis, and collapse. In Gillespie's case 5 powdered nutmegs had been taken to procure an abortion.

Treatment of Poisoning.—An emetic of zinc sulphate, 30 grains (2 Gm.), followed by small repeated doses of aromatic spirit of ammonia.

THERAPEUTIC USES.—The volatile oil may be used as a rubefacient in rheumatism, neuralgia, and paralysis. Internally the powdered or grated drug is used as a carminative, anodyne, and astringent, to relieve nausea, and for diarrhea, colalgia, and intestinal spasms. Small doses favor digestion by stimulating the secretion of the gastric juice. In delirium tremens, the narcotic properties of nutmeg may be utilized. W.

NUX VOMICA AND STRYCHNINE.—Nux vomica (poison nut, vomit nut, Quaker buttons, semen strychni) consists of the dried, ripe seeds of *Strychnos nux-vomica*, a tree of the natural order Loganiaceæ, growing in the East Indies, Ceylon, Cochin China, and northern Australia. All parts of the tree are bitter and poisonous. The seeds are disk-shaped, about an inch in diameter and one-sixth inch thick, covered with silky hairs, of a grayish-yellow or grayish-green color, and grayish white internally. They are very tough and are reduced to powder with difficulty. While devoid of odor, they are very bitter to the taste. These seeds con-

tain the alkaloids *strychnine* and *brucine* in the total amount of from 1.5 to 5 per cent., the former alkaloid constituting from one-third to one-half of the whole. In combination with these alkaloids is found a body related to tannic acid, viz., *igasuric acid*. There are also present the glucoside *loganin*, a yellow coloring matter, a concrete oil, gum, starch, wax, and earthy phosphates. The powdered drug varying in alkaloidal strength, it is necessary to have the preparations of *nux vomica* standardized to insure uniformity of physiological effect.

[*Ignatia* may be briefly considered here on account of its close resemblance to *nux vomica*, not only as to alkaloidal constituents, but also on account of the similarity of its physiological action and therapeutic uses. *Ignatia* (bean of *St. Ignatius*) is the seed of the *Strychnos ignatii*, a woody climber indigenous to the Philippine Islands, where the seeds have been used as medicine by the natives. The Jesuit missionaries named it in honor of the founder of their order. The seeds of *ignatia* are irregular in shape, slightly ovoid or oblong, grayish black, and more or less translucent, and contain about the same percentage of the two alkaloids as *nux vomica*. Tincture of *ignatia* (unofficial) may be given in doses of 1 to 15 minims in all diseases in which *nux vomica* is indicated.]

PREPARATIONS AND DOSE.

—The official preparations of *nux vomica* are as follows:—

Nux vomica, U. S. P. (*nux vomica*), the entire or powdered seed, required officially to contain not less than 2.5 per cent. of the alkaloids of *nux vomica*. Dose, 1 grain (0.06 Gm.).

Extractum nucis vomicæ, U. S. P. (extract of *nux vomica*), made by maceration of *nux vomica* in a 5:13 dilution of acetic acid, percolation, and extraction with alcohol, by an officially prescribed process. The dry extract

finally obtained is required to contain from 15.2 to 16.8 per cent. of the alkaloids of *nux vomica*. Dose $\frac{1}{6}$ to $\frac{1}{2}$ grain (0.01 to 0.03 Gm.).

Fluidextractum nucis vomicæ, U. S. P. (fluidextract of *nux vomica*), made by digestion of *nux vomica* with a mixture of water, alcohol, and acetic acid, followed by percolation. The fluidextract is required to yield from 2.37 to 2.63 per cent. of the alkaloids of *nux vomica*, i.e., approximately 1 per cent. of strychnine. Dose, 1 to 3 minims (0.06 to 0.2 c.c.).

Tinctura nucis vomicæ, U. S. P. (tincture of *nux vomica*), made by dissolution of 2 parts by weight of extract of *nux vomica* in 100 parts by volume of a 3:1 mixture of alcohol and water. It is required to contain 0.237 to 0.263 per cent. of alkaloids. Dose, 5 to 20 minims (0.3 to 1.25 c.c.).

Following is a description of strychnine and its official salts and preparations:—

Strychnina, U. S. P. (strychnine; strychnia) [$C_{21}H_{22}N_2O_2$], an alkaloid occurring in colorless prismatic crystals or as a white crystalline powder. While odorless, strychnine has an intensely bitter taste, perceptible in a solution as dilute as 1:700,000. It is soluble only in 6400 parts of cold water, in 5500 parts of ether, in 110 parts of alcohol, and in 6 parts of chloroform. Dose, $\frac{1}{100}$ to $\frac{1}{15}$ grain (0.0006 to 0.004 Gm.); average, $\frac{1}{60}$ grain (0.001 Gm.).

Strychninæ nitras, U. S. P. (strychnine nitrate) [$C_{21}H_{22}N_2O_2.HNO_3$], occurring in colorless needles with an intensely bitter taste. It is soluble in 42 parts of cold water, 8 parts of water at 80° C., 120 parts of alcohol, and 156 parts of chloroform; it is insoluble in ether. Dose, $\frac{1}{80}$ to $\frac{1}{12}$ grain (0.00075

to 0.005 Gm.); average, $\frac{1}{60}$ grain (0.001 Gm.).

Strychninæ sulphas, U. S. P. (strychnine sulphate) $[(C_{21}H_{22}N_2O_2)_2.H_2SO_4 + 5H_2O]$, occurring in colorless prismatic crystals or as a white crystalline powder, with an intensely bitter taste. Strychnine sulphate effloresces in dry air. It is soluble in 31 parts of cold water, 6 parts of water at 80° C., 65 parts of alcohol, and 325 parts of chloroform; it is insoluble in ether. Dose, $\frac{1}{80}$ to $\frac{1}{12}$ grain (0.00075 to 0.005 Gm.); average, $\frac{1}{60}$ grain (0.001 Gm.).

Elixir ferri, quininæ, et strychninæ phosphatum, U. S. P. VIII (elixir of iron, quinine, and strychnine phosphates), each fluidram (4 c.c.) of which contains about 1 grain (0.06 Gm.) of ferric phosphate, $\frac{1}{2}$ grain (0.03 Gm.) of quinine, and $\frac{1}{60}$ grain (0.001 Gm.) of strychnine. Dose, 1 fluidram (4 c.c.).

Glyceritum ferri, quininæ, et strychninæ phosphatum, U. S. P. VIII (glycerite of the phosphates of iron, quinine, and strychnine), each 15 minims (1 c.c.) of which contains about $1\frac{1}{4}$ grains (0.08 Gm.) of soluble ferric phosphate, 2 grains (0.12 Gm.) of quinine phosphate, and $\frac{1}{80}$ grain (0.0008 Gm.) of strychnine. Dose, 15 minims (1 c.c.).

Syrupus ferri, quininæ, et strychninæ phosphatum, U. S. P. VIII (syrup of the phosphates of iron, quinine, and strychnine), made by mixing 1 part of the preceding preparation with 3 parts of syrup. Dose, 1 fluidram (4 c.c.).

Syrupus hypophosphitum compositus U. S. P. VIII (compound syrup of hypophosphites), containing in every 2 fluidrams (8 c.c.) $\frac{1}{80}$ grain (0.0008 Gm.) of strychnine and $\frac{1}{8}$ grain (0.008 Gm.) of quinine, in addition to

a mixture of the hypophosphites of calcium, potassium, sodium, iron, and manganese, some hypophosphorous acid, and some sodium citrate. Dose, 2 fluidrams (8 c.c.).

Ferri et strychninæ citras, U. S. P. VIII (iron and strychnine citrate), containing 16 per cent. of iron and about 1 per cent. of strychnine, and occurring in garnet-red to yellowish-brown scales, with a bitter, mildly ferruginous taste, deliquescent when exposed to moist air, soluble in water and partly soluble in alcohol. Dose, 2 grains (0.125 Gm.).

Following are preparations of nux vomica and strychnine recognized in the National Formulary:—

Elixir phosphori et nucis vomicæ, N. F. (elixir of phosphorus and nux vomica), each fluidram (4 c.c.) of which contains $\frac{1}{60}$ grain (0.001 Gm.) of phosphorus and 2 minims (0.12 c.c.) of tincture of nux vomica. Dose, 1 fluidram (4 c.c.).

Pilulæ aloes et podophylli compositæ, N. F. (compound pills of aloes and podophyllum), each pill containing 1 grain (0.06 Gm.) of purified aloes, $\frac{1}{2}$ grain (0.03 Gm.) of resin of podophyllum, and $\frac{1}{4}$ grain (0.015 Gm.) each of extract of nux vomica and extract of belladonna leaves. Dose, 1 pill.

Pilulæ ferri, quininæ, aloes, et nucis vomicæ, N. F. (quadruplex pills) each containing 1 grain of dried ferrous sulphate, quinine sulphate, and purified aloes $\frac{1}{4}$ grain (0.015 Gm.) of extract of nucis vomica and extract of gentian, a sufficient quantity. Dose, 1 pill.

Elixir cinchonæ alkaloidorum, ferri, et strychninæ, N. F. (elixir of cinchona, iron, and strychnine), each fluidram (4 c.c.) containing with small

quantities of cinchona alkaloids, 2 grains (0.125 Gm.) of soluble ferric phosphate and $\frac{1}{100}$ grain (0.0006 Gm.) of strychnine sulphate. Dose, 1 fluidram (4 c.c.).

Elixir cinchonæ alkaloidorum, ferri, bismuthi, et strychninæ, N. F. (elixir of cinchona, iron, bismuth, and strychnine). Same ingredients as the preceding with the addition of 1 grain (0.06 Gm.) of bismuth and sodium citrate. Dose, 1 fluidram (4 c.c.).

Elixir cinchonæ pepsini, et strychninæ, N. F. III (elixir of cinchona, pepsin, and strychnine), each fluidram (4 c.c.) of which contains, in addition to small quantities of cinchona alkaloids, 1 grain (0.06 Gm.) of pepsin and $\frac{1}{100}$ grain (0.0006 Gm.) of strychnine sulphate. Dose, 1 fluidram (4 c.c.).

Elixir ferri pyrophosphatis; quinina, et strychninæ, N. F. (elixir of iron pyrophosphate, quinine, and strychnine), each fluidram (4 c.c.) of which represents 2 grains (0.12 Gm.) of soluble ferric pyrophosphate, $\frac{1}{2}$ grain (0.03 Gm.) of quinine sulphate, and $\frac{1}{100}$ grain (0.0006 Gm.) of strychnine sulphate. Dose, 1 fluidram (4 c.c.).

Elixir ferri, quinina, et strychninæ, N. F. (elixir of iron, quinine, and strychnine), each fluidram (4 c.c.) of which represents 1 grain (0.06 Gm.) of ferric chloride, $\frac{1}{2}$ grain (0.03 Gm.) of quinine hydrochloride, and $\frac{1}{100}$ grain (0.0006 Gm.) of strychnine sulphate. Dose, 1 fluidram (4 c.c.).

Elixir pepsini, bismuthi, et strychninæ, N. F. (elixir of pepsin, bismuth, and strychnine), each fluidram (4 c.c.) of which represents $\frac{1}{2}$ grain (0.03 Gm.) of pepsin, 2 grains (0.12 Gm.) of bismuth and sodium tartrate, and $\frac{1}{100}$ grain (0.0006 Gm.) of strychnine. Dose, 1 fluidram (4 c.c.).

Syrupus phosphatum cum quinina et strychnina, N. F. (compound syrup of hydrochloro phosphates), each fluidram (4 c.c.) of which represents $\frac{1}{4}$ grain (0.015 Gm.) of quinine, $\frac{1}{128}$ grain (0.0005 Gm.) of strychnine, and 2 grains (0.12 Gm.) of ferric phosphate, together with citrophosphates of potassium, magnesium, and calcium. Dose, 1 fluidram (4 c.c.).

Strychnine arsenate [$C_{21}H_{22}N_2O_2 \cdot H_3AsO_4 + \frac{1}{2}H_2O$], an unofficial salt of strychnine, occurs as a white, crystalline bitter-tasting powder, soluble in 14 parts of water. Dose, $\frac{1}{60}$ to $\frac{1}{15}$ grain (0.001 to 0.004 Gm.).

Brucine, the secondary alkaloid of nux vomica and ignatia, is not official. It occurs in white crystals having the chemical composition, $C_{23}H_{26}N_2O_4 + 4H_2O$, soluble in alcohol and chloroform, but insoluble in water. Salts of the alkaloid, such as the hydrochloride, nitrate, and sulphate, which are soluble in water, are also commercially available. Dose, $\frac{1}{12}$ to $\frac{3}{4}$ grain (0.005 to 0.05 Gm.).

MODES OF ADMINISTRATION.—Strychnine salts may be given in solution by mouth or rectum or injected subcutaneously or intramuscularly.

To obtain tonic effects either strychnine or nux vomica may be given by mouth in a fluid preparation or in capsules, pills, or tablet triturates. To secure the effect of the drug as a bitter, tincture of nux vomica, administered in water ten or fifteen minutes before meals, is generally given preference. Ascending doses of strychnine are frequently employed for tonic effects; after reaching the maximum amount and continuing it for a short period, the dosage is then usually brought down again gradually.

In giving strychnine sulphate in ascending doses, hypodermically, for tonic purposes, the author uses a 1 per cent. solution and administers initial doses of 0.003 Gm. ($\frac{1}{20}$ grain) in women and 0.004 Gm. ($\frac{1}{15}$ grain) in men. These are increased daily by 0.0005 Gm. ($\frac{1}{120}$ grain) until the limit of tolerance is reached, as shown by a feeling of slight intoxication, mild vertigo, stiffness of the jaw, or rigidity in the lower extremities. This reaction generally appears at 0.005 to 0.006 Gm. ($\frac{1}{12}$ to $\frac{1}{10}$ grain) in women and 0.006 to 0.007 Gm. ($\frac{1}{10}$ to $\frac{1}{9}$ grain) in men. The same dose is then injected on successive days until the effects are no longer produced, when a further increase in the dose is begun, more gradually, however, than before, *e.g.*, by 0.00025 Gm. ($\frac{1}{250}$ grain) only, or less, according to the subjective condition. The dose may thus be increased to 0.01 or 0.02 Gm. ($\frac{1}{6}$ or $\frac{1}{3}$ grain), which may even be repeated once or twice in a single day, for six hours; after each injection all summation of effect disappears. Such medication is indicated in neurasthenic states. Far from causing restlessness, the injections quiet psychic activity, relieve anxiety, and restore sleep. In simple **neurasthenia** permanent recovery usually takes place in from ten days to two weeks. In pseudoneurasthenia, however, the product of autosuggestion, and in mild forms of melancholia, frequently confounded with neurasthenia, strychnine is powerless, though harmless, and serves merely to point out the line of treatment to be followed, *viz.*, suggestion. Other conditions in which strychnine is valuable are spinal and neural affections leading to **hypotonia** and **atrophy**, **tabes dorsalis**, **cachexias**, **convalescence**, **tuberculous disease**, etc. Contraindications are few, and in giving numerous injections the author has seen no untoward result. That there is no tendency to habit-formation is shown in that the giving of 0.02- and 0.03- Gm. ($\frac{1}{3}$ and $\frac{1}{2}$ grain)

doses could be quite abruptly broken off with impunity. P. Hartenberg (*Presse méd.*, Jan. 25, 1913).

The author has given daily doses of 0.02, 0.03, and even 0.04 Gm. ($\frac{1}{3}$, $\frac{1}{2}$, and $\frac{2}{3}$ grain) of strychnine without even witnessing any serious untoward effect. The larger the dose given the more marked the therapeutic results. He has given strychnine to many heart cases without untoward phenomena. In a case of **syphilitic myelitis** 0.015 Gm. ($\frac{1}{4}$ grain) was given daily for two months, then 0.024 Gm. ($\frac{1}{3}$ grain) for six weeks, and finally 0.03 Gm. ($\frac{1}{2}$ grain) for nearly a year, without unpleasant effects. In conjunction with small doses of mercury cyanide, intravenously, the strychnine led to a gradual disappearance of bladder and locomotor paralysis. A dosage of 0.02 to 0.035 Gm. ($\frac{1}{3}$ to $\frac{1}{2}$ grain) daily gives the best results; this amount may be attained in a few days, and only exceptionally gives rise to a sense of mild "intoxication," with slight headache and muscular rigidity. These promptly disappear if the dose is even slightly diminished. In marked **collapse** and **acute lung edema**, 0.01 Gm. ($\frac{1}{6}$ grain) and even 0.015 Gm. ($\frac{1}{4}$ grain) may be injected at a dose, to be repeated, if required, in three, four, or five hours. In **alcoholics**, as much as 0.04 or 0.05 Gm. ($\frac{2}{3}$ to $\frac{5}{6}$ grain) may be given in twenty-four hours. Strychnine nitrate is preferable to the sulphate in that it contains 6 per cent. more of the pure alkaloid, and is anhydrous, and therefore invariable in strength, whereas the sulphate varies in activity according to whether it has effloresced or not, and the amount of water of crystallization it has taken up in separating from its solutions. The author gives, to accustomed individuals, 0.008 to 0.12 Gm. ($\frac{1}{8}$ to $\frac{1}{5}$ grain) of strychnine in pill form during or after each meal. For **alcoholics**, and in cases of **infectious disease** where temporarily the heart must be sustained and general depression combated with drugs, and

where caffeine, camphor, ether, and epinephrin seem the only resources left, strychnine in full doses is a valuable reserve measure. P. Troisfontaines (*Presse méd.*, March 29, 1913).

Children, owing to the relatively great sensitiveness of their spinal cord, are more readily influenced by strychnine than adults. The dosage should therefore be somewhat smaller. For a child of 5 or 6 years, the initial dose should not exceed $\frac{1}{100}$ grain (0.0006 Gm.).

INCOMPATIBILITIES.—Strychnine salts are incompatible with iodides, bromides, and ammonium chloride; with alkalies, alkali carbonates and bicarbonates; with benzoates, salicylates, dichromates, and cyanides; with tannic acid, and with oxidizing agents in general. They may be successfully combined with potassiomeric iodide by the addition of acacia (gum arabic).

CONTRAINDICATIONS.—Strychnine is contraindicated in acute inflammatory states of the spinal cord, including epidemic poliomyelitis, in acute and subacute neuritis, and whenever the reflexes are already exaggerated. In neurotic individuals who are introspective along sexual lines strychnine should not be given. In patients with thickened, tortuous blood-vessels and in sclerotic nephritis, chronic gout, and syphilis in its later stages, some caution should be exercised. Where cerebral hemorrhage threatens the drug is, of course, absolutely contraindicated. As a rule, strychnine should be withheld in neurotic or hysteric persons until some definite occasion for its use, such as exhaustion due to an intercurrent condition, arises.

In children it should be borne in mind that long-continued administra-

tion of strychnine or nux vomica may bring on a state of peevishness, talkative delirium, or even temporary insanity.

PHYSIOLOGICAL ACTION.—The action of strychnine, the chief alkaloid of nux vomica, may be taken as practically representing that of the entire crude drug, brucine having only a relatively feeble influence, and one which in the main merely reinforces the action of the strychnine.

Externally, strychnine exerts only a slight irritant action.

General Effects.—*Nervous System.*—Strychnine causes a pronounced increase in reflex excitability, particularly in the spinal cord, to a less extent in the brain. From its action on the cerebrum there results an increase in the processes of intellection, and a slight diminution in mental fatigue; these effects, however, are not nearly as pronounced as in the case of caffeine. Strychnine, by stimulating all perceptive centers, including those concerned with the special senses, augments tactile and pain sensation and increases the acuteness of the senses of hearing, smell, and taste. Vision also becomes keener, especially in the distinction of different colors. Since the latter influence is exerted even upon mere instillation of a solution of the drug in a single eye, in which case the effect is limited to that eye, the action in this respect is believed to take place at least in part in the retinal cells, which the drug reaches through the lymphatics.

In respect of the spinal cord, small doses of strychnine cause merely an exaggeration of the motor response normally resulting from a sensory stimulus received at the surface of the body and transmitted to the spinal cord.

through the sensory nerves. Larger doses cause muscular twitchings or actual convulsions. That these convulsions are due to excitation of spinal motor activity rather than to an influence on motor cells in the brain is suggested by the fact that the four limbs generally go into convulsions simultaneously, and is positively proved by the observation that cutting the spinal cord—*e.g.*, in the frog—does not prevent convulsions in muscles supplied from nerve-cells in the cord below the point cut. In truth, there is no satisfactory evidence that the motor nerve-cells are stimulated by strychnine either in the spinal cord or brain. Experimental work in animals has shown clearly that powerful stimulation of the sensory cells is by far the most important nervous effect of this alkaloid. The sensory side of the spinal cord is rendered so sensitive that even a slight stimulus from the skin surface brings about a motor response of the entire cord, manifested in a general tonic spasm. The drug not only facilitates the passage of a sensory impulse to the special group of motor cells normally reached from the application of a stimulus to a given locality, but also opens up paths to other motor cells, so that cells normally uninfluenced by a stimulus respond readily where strychnine has been employed. Where the dose given is not sufficient to produce twitchings, motor response, while more intense than normally, does not lose its purposive character; where, on the other hand, a convulsive dose is administered, all purposive reflex activity is interfered with, and co-ordinated reflex actions, in which, when one group of muscles contracts, inhibition of the opposing muscles occurs, can no

longer take place; in fact, the normal inhibition of opposing muscles is replaced by excitation, the result being a spastic condition.

In the case of the skeletal muscles, the reflex inhibition of the extensors during flexion, or of the flexors during extension, at a joint is transformed, under the action of strychnine, into a reflex excitation. The same thing holds, according to Bayless, in the case of many vasomotor reflexes; the depressor nerve, for example, normally excites vasodilator neurons and inhibits vasoconstrictor neurons; under strychnine it excites both. Inhibitory reflexes which have been transformed into excitation under strychnine again assume their normal character under chloroform. T. Hough (*Va. Med. Semi-Monthly*, Feb. 12, 1909).

When the lower half of the spinal cord is poisoned by the transfusion method, spasms confined entirely to the lower half of the animal occur when the skin of that region is stimulated. The spasms then become spontaneous in the lower half of the animal. As the poisoning increases the spasms become general, occurring in the upper unpoisoned half when the lower half is stimulated. Spontaneous general spasms then ensue. If at this stage the spinal cord is cut at a level just between the poisoned and unpoisoned portions, the spasms cease in the upper half of the animal, while they continue below, indicating that the upper half is unpoisoned. An injection of strychnine subsequently into the upper part of the animal again throws it into spasms. If the poisoning be more gradual, as obtained by directly applying strychnine to the spinal cord in different regions, the symptoms of strychnine poisoning are slower to develop and stages intermediate to those just described occur, beginning with exaggerated reflexes and ending with spontaneous spasms, but always localized in the beginning to the poisoned region.

Later, symptoms are manifested in unpoisoned regions. A. H. Ryan and H. McGuigan (Jour. of Pharmacol. and Exper. Therap., March, 1911).

Strychnine acts on both motor and sensory neurons, and no tetanus can develop from its action unless the motor neuron is directly acted on by it. McGuigan and Becht (Jour. of Pharm. and Exper. Therap., May, 1914).

On the centers in the medulla oblongata strychnine exerts a well-marked stimulant action, which, however, rather readily gives way to depression where an excessive dose has been used. In strychnine poisoning death in some instances is caused by this secondary depression of the medullary centers.

On the peripheral nervous structures—nerve-trunks and nerve-endings—strychnine has no influence in man, though in frogs poisoned with it a curare action—paralysis of motor nerve-endings—is at times discernible.

Circulation.—In therapeutic doses, strychnine tends to stimulate the vasoconstrictor and vagus centers in the medulla, thus causing at times a slight rise in blood-pressure and a slight slowing of the pulse rate. In perfusion experiments on the mammalian heart little or no evidence of a direct stimulant action on this organ by moderate amounts has been obtained, yet from clinical observation in certain cardiac cases strychnine is credited with a tonic influence upon the heart muscle, and the experiments of Cameron have tended to substantiate this view. Clinical tests of the effect of ordinary doses of strychnine on blood-pressure have yielded varying results in the hands of different observers. According to Cook and Briggs there is no effect on the pressure under normal

conditions, but in ill persons a gradual rise in pressure results, lasting from one to four hours.

The only type of low pressure favorably affected by strychnine is that characterized by moderate depression of the vasomotor center. Pamment (Jour. Amer. Med. Assoc., July 20, 1912).

Strychnine, applied to the isolated hearts of rabbits, fish, and frogs, exerts a marked and prolonged stimulating effect. A. A. Tetjeff (Roussky Vrach, May 18, 1913).

Toxic doses of strychnine may be administered at short intervals during periods up to 12 days, the total being 25 times the single fatal dose, without causing perceptible lasting effects. Only a small percentage of the strychnine so administered can be recovered from the urine, and none from the feces. The excretion in the urine usually ceases within 24 to 48 hours. The experiments indicated that strychnine was rapidly destroyed in the bodies of animals, particularly in the liver. Hatcher and Eggleston (Jour. of Pharm. and Exper. Therap., Oct., 1917).

With toxic doses of strychnine the vasoconstrictor and vagus centers are finally depressed. During convulsions the blood-pressure is greatly increased, not through any direct effect of the drug on the vessel walls, but by reason of the pressure exerted on the vessels by the violently contracting muscles.

Respiration.—Strychnine is a strong stimulant to the respiratory centers in the medulla, the breathing being increased both in rate and amplitude by large therapeutic doses. In experiments on dogs Wood recorded a 75 to 300 per cent. increase in the respiratory air movement under strychnine. The irritability of the centers implicated in cough is likewise increased; where there is inability to cough up excessive

secretions, strychnine may therefore be used to render cough more effectual. In addition, strychnine tends to tone up the bronchial musculature, and can thus be administered with advantage where the bronchi are relaxed.

Reports of experiments with strychnine on healthy students. The drug was given hypodermically in doses of $\frac{1}{40}$, $\frac{1}{30}$ and $\frac{1}{20}$ grain (0.001, 0.002, 0.003 Gm.). It had no effect on the rate of respiration, except in the dose of $\frac{1}{20}$ grain (0.003 Gm.), which produced an average increase of one per minute; this effect varied markedly in the different students, a drop in the rate occasionally occurring without apparent cause. A slowing of the pulse rate resulted from all doses, and a marked increase in blood-pressure from the $\frac{1}{30}$ - and $\frac{1}{20}$ -grain (0.002 and 0.003 Gm.) doses. David Marvin (Arch. of Internal Med., April, 1913).

Toxic doses of strychnine may kill either through excessive excitation of the respiratory centers, the respiratory muscles being thrown into a condition of spasm and therefore of functional inefficiency, or through secondary exhaustion of the same centers, death taking place similarly from asphyxia.

Alimentary Tract.—Here strychnine produces effects both locally and after absorption into the general system. The initial effect is that of a bitter, the intense bitter taste of the alkaloid stimulating the taste buds in the mouth, and thereby restoring appetite where lost and exciting a flow of the “appetite” or “psychic” gastric juice. The bitterness also causes a reflex flow of saliva. Both the amount and the digestive power of the gastric juice have been found to be increased by strychnine. In the intestine it stimulates peristalsis,—an effect presumed

to be due to an increase in the irritability of the local nerve-centers governing peristalsis, viz., the ganglion cells of the plexus of Auerbach. Augmented secretory activity through reflex action—an effect analogous to the augmented motor activity (convulsions) resulting from stimulation of the spinal sensory cells under the influence of large doses—is also considered to be, in all probability, one of the beneficial actions of strychnine. An increase in the tone of the gastric and intestinal muscles is, furthermore, ascribed to the effect of strychnine upon the spinal cord after its absorption.

Muscles.—Strychnine has no direct action on muscle tissue, but promotes muscular power by increasing the tone of the nerve-centers supplying muscle tissue and augmenting reflex activity.

Metabolism.—Strychnine causes an increase in metabolism through the improvement of tone it occasions in muscle tissue by reason of its influence on the spinal nerve-cells. Oxygen consumption and liberation of carbon dioxide are both increased.

Temperature.—A slight increase of body temperature may take place under strychnine owing to augmented heat production in the muscles; this augmented heat production seems, however, usually to be compensated for by dilatation of the skin vessels, heat dissipation being thereby increased sufficiently to keep the temperature quite constant.

Absorption and Elimination.—Absorption of strychnine from the stomach and especially from the intestine is rather rapid. A portion of the drug absorbed is destroyed in the system, but a considerable remainder is eliminated through the kidneys and also with the sweat, saliva, and bile. Elimination

nation begins promptly, and most of the drug taken in is gotten rid of within twelve hours; the residual amount, however, may be present in the urine for four, five, or even eight, days. In the urine strychnine appears both as such and in the form of strychnic acid, an oxidation product of strychnine.

According to Meltzer, strychnine is absorbed with equal rapidity from the small intestine, colon, and rectum. In some experiments only two or three minutes elapsed between introduction of the drug in the rectum and the appearance of convulsions. The stomach was found to absorb strychnine more slowly than either the intestine or the esophagus.

Brucine.—Brucine is many times weaker than strychnine as a convulsant, though resembling it in its action in a general way. In addition it possesses a distinct local anesthetic action in 5 or 10 per cent. solutions.

UNTOWARD EFFECTS AND POISONING.—The preliminary signs of strychnine poisoning may be witnessed when this alkaloid or nuxvomica is given in rapidly ascending or unnecessarily large repeated doses, and consist in restlessness and nervousness, exaggerated reflexes, muscular twitchings, and sometimes a feeling of rigidity in the neck or stiffness in walking. Sensations of stiffness in the facial muscles, particularly in laughing, or in the throat, jaws, or chest may also be experienced. Sudden movements, such as shrugging of a shoulder, or abrupt jerking of an arm or leg, are additional rather characteristic manifestations. Formication and other paresthesias have been noted in some cases of incipient strychnine poisoning.

After large toxic doses of strychnine have been taken symptoms usually appear in from fifteen to twenty minutes, rarely later than an hour, and often with great suddenness. Sometimes the convulsions are preceded by partial spasms of the muscles of the extremities, but frequently the patient is suddenly thrown down in a general tetanic spasm. The condition is then one of profound opisthotonos, the body being bent backward and resting upon the heels and head. The legs are extended, the feet everted, the arms bent, and the hands clenched. The eyes, staring, are wide open, and the corners of the mouth are drawn up (*risus sardonicus*). The face is at first pale, but may become livid from interference with respiration. Consciousness is not affected unless asphyxia is so pronounced as to threaten death. The senses are often more acute than normally, but tinnitus and amaurosis may be present if the paroxysms are severe. The muscles of the jaw are generally the last in the body to become affected, but trismus finally comes on in severe cases, and in a certain proportion of instances appears early in the course of the poisoning. While death may occur in the first convulsion in animals, no instance of such prompt death has been recorded in man (Tardieu).

After a shorter or longer time muscular relaxation sets in and a period of calm ensues, to be succeeded by a second convulsion. The slightest noise, draught of air, or touch may cause a convulsion or series of convulsions, the sensory impulse reaching the spinal cord causing exaggerated motor impulses to be sent out to the muscles. A firm grasp or hard

rubbing of the muscles is frequently grateful to the patient under these circumstances. During the spasms progressive asphyxia develops, the respiratory muscles being in a state of tetanic rigidity; during the periods of relaxation, on the other hand, the patient breathes easily, except when secondary depression of the respiratory centers has become pronounced. A slight rigidity is sometimes present during the periods of relaxation, but no marked stiffness. The cramp-like contraction of the muscles is generally, but not always, very painful. Erections of the penis are not infrequent, and the urine and feces may be voided involuntarily.

If the case is to terminate favorably, the convulsions gradually lessen in severity and finally cease, leaving the patient exhausted, with a sore, tired feeling in the muscles from overcontraction. Death, if it occurs, takes place usually within two hours, either from cramp asphyxia (rigidity of the respiratory muscles) or from exhaustion or secondary depression of the medullary centers. The heart may continue beating for a time after breathing has stopped. Post-mortem examination reveals the usual congestive lesions of death by asphyxia, as well as, at times, indications of spinal hyperemia. In cases that recover, albuminuria is at times noted for a short period.

Strychnine is an extremely permanent body, and has been recovered from the tissues eleven years after burial. The tissues in which it has been commonly found in quantity, besides the contents of the stomach and urinary bladder, are the liver and kidneys.

The post-mortem appearances considered to be in accordance with, if

not characteristic of, poisoning by strychnine, are: (1) The usually rapid onset of cadaveric rigidity. (2) The evidences of death during a convulsive seizure; the lips may sometimes bear evidences of having been bitten. (3) The mottling of dependent parts. (4) Internally, the blood is fluid and of a very dark color. (5) General congestion of internal organs, especially marked in the meninges and cortex of the brain and spinal cord. (6) The left ventricle of the heart invariably empty and contracted, and the right ventricle containing but a small amount of blood, and that fluid. (7) The stomach unaffected internally. H. A. Spencer (Transvaal Med. Jour., May, 1908).

The minimum fatal dose of strychnine is generally placed at about $\frac{1}{2}$ grain (0.03 Gm.). Incipient toxic effects were noted in a woman who had taken $\frac{1}{12}$ grain (0.005 Gm.). One one-hundredth of a grain (0.00065 Gm.) is said to have killed a child $3\frac{1}{2}$ months old; 10, 20, and 22 grains (0.6, 1.3, and 1.4 Gm.), taken upon a full stomach and retained two hours, failed to cause death in each case, probably on account of slow absorption (Wood). Tolerance to the drug, established through gradually ascending dosage, will, of course, increase the minimum lethal quantity; $\frac{4}{5}$ grain (0.05 Gm.) in a day is easily borne where tolerance has been developed.

Diagnosis of Strychnine Poisoning.

—Strychnine poisoning may be confounded with tetanus. The convulsions of strychnine poisoning do not resemble those of epilepsy, as they are distinctly tonic and never clonic.

In *tetanus* the locking of the jaws (trismus) comes first; in strychnine poisoning it usually comes last. The convulsions of tetanus rarely, if

ever, completely relax; in strychnine poisoning periods of relaxation occur. In tetanus there is usually the history of an injury, or of a rusty nail or needle run into the foot or other part of the body. The more prolonged course of the disturbance present may also at times be available as a diagnostic indication.

Treatment of Strychnine Poisoning.—If no symptoms have appeared, the first measure adopted should be to **wash out the stomach** thoroughly. The chemical antidotes—as **tannic acid** (30 grains; 2 Gm.), **strong tea** (*ad libitum*), **Lugol's solution** (1 fluidram; 4 c.c.), or **potassium permanganate** (generous amounts of a 1:1000 solution)—may now be administered, but should be followed by a quickly acting **emetic** or the use of a **stomach tube**, as the compounds formed by these substances are not permanent. **Potassium bromide** ($\frac{1}{2}$ ounce—15 Gm.) combined with **chloral hydrate** ($\frac{1}{2}$ to 1 dram—2 to 4 Gm.) should be given, and every twenty minutes afterward, if necessary, 2 drams (8 Gm.) of the bromide, and 15 grains (1 Gm.) of chloral. The bromide and chloral are physiological antidotes, the former depressing especially the sensory side of the cord, and the latter the motor side. **Powdered charcoal** has been credited with some value as an absorbent of the poison in the stomach.

Where convulsions have already appeared when the case is seen, immediate **inhalation of chloroform** or **ether** is indicated, these agents, as strong depressants to the spinal cord, counteracting the exciting effect of strychnine. Chloroform, acting rapidly, may with advantage be administered first, and ether later substituted

for it in view of its less harmful action on parenchymatous organs where prolonged anesthesia is required. **Amyl nitrite** may also be used in strychnine convulsions, preferably by **inhalation**, but is decidedly less effective than the general anesthetics mentioned. It should be borne in mind, however, that anesthetic drugs must be used carefully in strychnine poisoning, as both chloroform and ether tend to augment the muscular relaxation customarily present between the convulsions, and especially since chloroform tends to depress further the already paretic respiratory center during the same intervals. The same drawback obtains in the case of chloral hydrate, the action of which must, therefore, be closely watched. Bastedo suggests that **paraldehyde**—less depressing to the respiration—be substituted for chloral hydrate. The anesthetics administered by inhalation are advantageous in that when depression appears their action can be discontinued more promptly than in the case of chloral and bromides.

When the convulsions have been brought under control, and while the patient is still under the influence of the anesthetic, a stomach-tube should be introduced and the stomach washed out with a warm solution of 1:1000 **potassium permanganate**. If chloral and bromides have not yet been administered, they may now be given in full yet not exaggerated amounts,—*e.g.*, 30 grains (2 Gm.) of **chloral** and 2 drams (8 Gm.) of **potassium** or **sodium bromide**, either by mouth or rectum,—to prolong the effect of the anesthetic. In determining the doses to be administered, the condition of the patient at the

time and the degree of likelihood of subsequent serious respiratory and circulatory depression should be thought of. To hasten elimination of the strychnine absorbed into the system **intravenous saline infusion**, causing free diuresis, and **catheterization** of the bladder, to remove the strychnine carried into the latter, have been strongly advised. Githens and Meltzer, from experimental work, recommend **ether anesthesia**, **intra-tracheal insufflation**, and **intravenous infusion of Ringer's solution** as the three most effectual therapeutic measures in strychnine poisoning.

A large man suffering from lymphatic leukemia received through error one morning 15 grains (1 Gm.) of strychnine sulphate in three capsules. The patient was found rigidly extended on his bed, conscious, extremely apprehensive, and complaining of intense pain in the back of the neck. From time to time his muscular rigidity increased suddenly. He was immediately given $\frac{1}{4}$ grain (0.016 Gm.) of **morphine**. A few minutes later, on attempting to pass a tube, it was found that the patient could not separate his jaws more than half an inch. The trismus rapidly increased and the patient passed into a severe tonic convulsion with cessation of respiration and intense cyanosis. Efforts made to open the mouth with a gag during the convulsion were unavailing. One-tenth grain (0.006 Gm.) of **apomorphine** was injected. Shortly after, the **stomach-tube** was successfully passed through a nostril and the stomach thoroughly washed out. The patient vomited milk curds repeatedly during this washing. The washing was repeated several times. Shortly after the second severe general convulsion, **chloroform anesthesia** was started. This was changed to **ether** an hour later, and the patient was kept continuously under the anesthetic for five and a

half hours more. An enema containing 40 grains (2.6 Gm.) of **sodium bromide** and 20 grains (1.3 Gm.) of **chloral hydrate** was early given. No further severe convulsions occurred, but milder convulsive movements were noted. Two drops of **croton oil** failed to act.

Urine was obtained by **catheter**. A pint of **saline solution**, with 10 grains (0.6 Gm.) of **diuretin**, was given by **rectum**, and this was repeated about once in two hours until noon of the following day. A flood of urine and numerous small stools were passed during the night. Repeated twitchings of the muscles were noted up to midnight. On the following morning the patient complained of soreness of the muscles. For several nights he was restless, and complained of muscular twitchings. Over $1\frac{3}{5}$ grains (0.104 Gm.) of strychnine were recovered from the urine of this patient. During the earlier stages of the poisoning the amount of urine was diminished, and very little strychnine excreted. Hewlett (Amer. Jour. Med. Sci., Oct., 1913).

A study in a human case and in animals showed that **magnesium sulphate**, given intraspinally, 1 c.c. (15 minims) of a 25 per cent. solution to each 20 pounds in adults, and $\frac{1}{2}$ of the dose in children, tends to control strychnine convulsions. Cutler and Alton (Jour. Exper. Med., Jan., 1917).

Throughout the course of the poisoning an absolutely quiet environment is to be sought for the patient, as even the slightest sensory stimuli, *e.g.*, touch or manipulation, a suddenly projected light, a draught of air or a sharp noise, will tend to bring on, in the unanesthetized patient, a convulsive attack. **Morphine** may be used in strychnine poisoning to relieve pain during the convulsive periods, but considerable caution in the dosage is necessary, in view of the well-known depressant effect of morphine on the respiratory center.

Nicotine and a **tobacco enema** have been used with apparent efficacy in strychnine poisoning, and **veratrum viride** in the dose of 1 fluidram (4 c.c.) of the tincture, followed by 2 drops every ten minutes, was credited by Ringer with having cured a bad case, but the uncertainty of action of the first-named drug, and the probable harmful influence of veratrum on the circulatory condition in the later stages of the poisoning are serious drawbacks. **Physostigmine salicylate** or **sulphate** in doses of $\frac{1}{30}$ grain (0.002 Gm.) or more is likely to prove more useful than either nicotine or veratrum. Batson administered two hypodermic injections of $\frac{1}{24}$ grain (0.0025 Gm.) of **pilocarpine hydrochloride** in a case of strychnine poisoning in a $2\frac{1}{2}$ -year-old child, sedation of the (clonic) convulsions and recovery following. Turner noted the favorable influence of ingesting large amounts of **lard** in experimental strychnine poisoning in animals.

Artificial respiration, oxygen inhalations, and external heat are considered of value chiefly in cases that reach the secondary phase of depression and exhaustion of the vital nerve-centers and circulation, though Gies and Meltzer assert that artificial respiration is useful to postpone the beginning of convulsions, and oxygen inhalations may be employed both immediately after convulsions to relieve the cyanosis and partial asphyxia resulting from the stoppage of respiration during the spasm, and to enhance the oxidation of strychnine in the system. Artificial respiration by the ordinary manual methods is practically useless during the violent convulsions, though if suitable

pumping apparatus be at hand (pulsomotor or intratracheal insufflation) the "forced" respiration thus imposed may save life. At the close of the convulsions artificial respiration may be useful in favoring the resumption of spontaneous breathing.

By means of **intratracheal insufflation** and the **intravenous injection of curarine**, the authors were able to save a majority of dogs in which a toxic dose of strychnine had been injected. In addition to these measures the animals were given an **intravenous infusion of salt solution**, that the strychnine might be eliminated more rapidly by the kidneys. The insufflation must be continued for a long period, ranging between three and seven and a half hours. A. O. Shaklee and S. J. Meltzer (Berl. klin. Woch., Sept. 26, 1910).

The authors injected twice the fatal dose of strychnine into a number of dogs and then introduced a catheter into the trachea and **etherized** the animals by the **insufflation** method. The convulsions could be very easily controlled in this way, and not one of the twenty animals died. At autopsy several days later, no changes were detected in the viscera. Even where the narcosis lasted for several hours only small quantities of ether were required. The results were not good with chloroform. T. S. Githens and S. J. Meltzer (Berl. klin. Woch., April 10, 1911).

THERAPEUTICS.—As a **respiratory and circulatory stimulant**, strychnine is of value, administered hypodermically in doses of $\frac{1}{20}$ to $\frac{1}{10}$ grain (0.003 to 0.006 Gm.), in some cases of shock,—especially the milder cases,—in **collapse**, and in **poisoning by various drugs**, particularly **hypnotics and narcotics** such as **chloral hydrate, alcohol, ether, chloroform, morphine, opium**, and the **coal-tar analgesics**, as well as in **poisoning by**

meat, fish, cheese, or toadstools. The stimulating action of strychnine on the respiratory centers is considered especially powerful, though not very lasting. It is to be borne in mind that where sufficient strychnine is given to produce a distinct effect on the blood-pressure, a secondary depression of the vasomotor center may easily occur. Although not credited with any marked power as a direct cardiac stimulant, strychnine is used, seemingly with success, in circulatory weakness, or actual collapse occurring in **infectious diseases**, *e.g.*, **bronchopneumonia**, **diphtheria**, **scarlet fever**, **septicemia**, **Rocky Mountain fever**, etc.

Large doses of strychnine may be of value in **Stokes-Adams disease**. In a case with severe symptoms of heart disease without complete degeneration, the patient had Stokes-Adams symptoms and remained with permanent heart-block for two years. The man was able to do his work during this period, with his pulse always below 30, and died suddenly one night while washing his hands. During the period referred to he was always perfectly well, provided he was taking $\frac{1}{20}$ grain (0.003 Gm.) of strychnine. If he went without it, his pulse would intermit for one-fourth of a minute. George Dock (Jour. Amer. Med. Assoc., June 22, 1912).

In a few cases of **pneumonia**, **typhoid fever**, and **heart disease**, the author observed well-marked favorable changes in the heart sounds and pulse after the use of strychnine. He also noted similar changes in a patient with phthisis, who took $\frac{1}{30}$ grain (0.002 Gm.) three times a day for several days. The heart sounds in this patient were considerably louder than normal, the second aortic being especially accentuated, and the pulse bounding. The author hesitates to believe that there are no con-

ditions in which strychnine is of value as a stimulant. G. C. Shattuck (N. E. Pediatric Soc.; Merck's Archives, July, 1913).

The direct stimulating effect of strychnine on the respiratory centers is also availed of in respiratory affections associated with **dyspnea** and perhaps **cyanosis**, as in **emphysema** and **hypostatic lung congestion**, or with **insufficient cough**, and the consequent **insomnia**. Thus, in **bronchitis** or **pulmonary tuberculosis** with much bronchial secretion, but a weak, ineffectual cough, strychnine may be indicated to augment the intensity of the coughing reflex. In the later stages of **pneumonia**, especially when collapse threatens, the combined circulatory and respiratory stimulant effects of strychnine are frequently of value. In **Asiatic cholera** or **bacillary dysentery** with threatening collapse, as well as in **summer diarrhea** with watery diarrhea, combined administration of nux vomica, opium, and mineral acids has been strongly recommended. If there be much pain, the following formula may be used:—

℞ *Strychninæ sulphatis* gr. $\frac{1}{4}$ (0.015 Gm.).
Acidī sulphurici diluti ℥ss (15 c.c.).
Morphinæ sulphatis. gr. ij (0.12 Gm.).
Aquæ camphoræ .. ℥iiss (100 c.c.).

M. Sig.: One teaspoonful every hour or two, well diluted.

Strychnine should be given in much larger doses than is customary. The author cured an **acute edema of the lungs** in a gouty subject by giving $\frac{1}{3}$ grain (20 mg.) of sulphate of strychnine in one hypodermic injection, and continuing to give fractional doses every hour until the crisis of the attack had passed. Troisfontaines (Gaz. méd. Belge, July 4, 1907).

Strychnine should be employed much more freely than in the past, its most frequent indications being: Traumatic **shock**, **prolonged fevers**, **coma** from chloral, opium, or alcohol; **neurasthenia** and **infantile** spinal paralysis. In the latter disease he injects it into the spinal cord. Neisser (Berl. klin. Wochen., Jan. 21, 1918).

As **general tonics** strychnine and nux vomica are used in a great variety of disorders associated with nervous depression and general weakness. Thus in **convalescence** from severe illnesses, and in other states of **debility** with more or less pronounced **anorexia**, **feeble digestion**, and more or less coated tongue, the action of the drug on general tonicity, as well as that on the appetite, is of well-recognized value. Not only does the drug act locally as a "bitter" and stimulant to peristalsis, but by stimulating the spinal cord it causes improved general muscular tone and probably a better functioning of the various visceral organs through activation of the reflexes governing the activity of these organs.

The following combination acts as a powerful stimulant to the various functions in slow convalescence from infections:—

A combination of strychnine with a mineral acid and infusion of gentian is appropriate where a bitter tonic effect is especially required under the same conditions.

R. Strychninæ sul-

phatis gr. j (0.06 Gm.).

Quininæ hydro-

chloridi 3ij (8 Gm.).

Phosphori gr. ss (0.03 Gm.).

M. et fac in pilulas no. lx.

Sig.: One pill after meals.

In mental or physical **exhaustion** due to overwork, strychnine is not

infrequently prescribed. Yet during periods of strenuous labor, strychnine can only be regarded as a temporarily acting whip to the nervous system; far preferable is its use where the period of strain is over, when restoration to the normal state may be hastened by it.

In wasting diseases, including **pulmonary tuberculosis** and **cancer**, strychnine or nux vomica is extensively used to improve the appetite and the digestive functions. In pulmonary tuberculosis it tends to prevent or relieve **night-sweats**. In the **anemias** it is also distinctly useful when employed as an adjunct to iron and arsenic. Morgan points out that in patients with a tendency to **melancholia**, with a markedly rundown system, as from poor feeding, etc., the use of strychnine in gradually ascending doses is almost invariably followed by a favorable reaction and general mental and physical improvement.

In **hemophilia**, strychnine or nux vomica may be used with benefit.

In nervous depression associated with **chronic intoxication by alcohol**, strychnine is not infrequently the remedy which will best control the morbid desire for alcoholic stimulation. Hypodermic injection of $\frac{1}{30}$ grain (0.002 Gm.) three or four times daily for a week, or possibly two weeks, will procure relief from the depression due to abstinence from alcohol preparations, partly by stimulation of the vesical functions through its effect on the spinal cord, partly by overcoming the vasomotor paresis caused by alcohol, and partly through its stomachic effect. **Tremor** in chronic alcoholics is at times checked by strychnine. In some cases, how-

ever, the spinal cord is already over-excited, as shown by unusual reflex activity (knee-jerk), and strychnine must then be used only with due caution. In **acute alcoholism**, $\frac{1}{10}$ grain (0.006 Gm.) of apomorphine hydrochloride and $\frac{1}{30}$ grain (0.002 Gm.) of strychnine sulphate form a useful combination to provoke emesis. In violent or delirious patients, $\frac{1}{15}$ grain (0.004 Gm.) of the apomorphine, combined with strychnine, will nearly always induce sedation and sleep (Blackader). In **delirium tremens**, similar combinations of strychnine with a sedative are not infrequently of value.

In **gastrointestinal disorders** nux vomica and strychnine are of decided value where improved appetite, secretion and motility are desired. Like other bitters, they produce a sensation of hunger, and, in addition, their excitant action on spinal and other reflexes tends to improve the gastrointestinal functions as a whole. In cases of **achylia gastrica** (atrophic gastritis) or so-called **atonic dyspepsia**, tincture of nux vomica may be given advantageously in doses of 5 to 20 minims (0.3 to 1.25 c.c.) fifteen or twenty minutes before meals. Where the stomachic effect is alone desired, 5- or 10- minim doses suffice, whereas, if increased motility is also an object in view, the larger doses are often necessary. Strychnine, $\frac{1}{60}$ to $\frac{1}{30}$ grain (0.001 to 0.002 Gm.), may be substituted for nux vomica, but is more rapidly absorbed, and its strictly local effects are, therefore, of shorter duration.

Kemp recommends the following combination in **achylia gastrica** (in **anorexia nervosa** the pepsin may be omitted:—

℞ *Tincturæ nucis vomicæ*,
Acidi hydrochlorici
dilutiāā f̄iij (12 c.c.).
Tincturæ cinchonæ
compositæ f̄ij (30 c.c.).
Pepsini puri ʒiss (6 Gm.).
Aquæ sterilæ ..q. s. ad f̄iiv (125 c.c.).

M. Sig.: One or 2 teaspoonfuls in water three times daily before meals.

The same author recommends simultaneous administration of strychnine arsenate, $\frac{1}{100}$ grain (0.0006 Gm.), and quassin, $\frac{1}{10}$ grain (0.006 Gm.), for stomachic purposes. In the dyspepsia of **Addison's disease** similar treatment is indicated.

In **acute gastric catarrh** accompanied by **sick-headache**, but without much nausea, due generally to some error in diet or to constipation, prompt relief is obtained from nux vomica. One drop of the tincture in a teaspoonful of water every five or ten minutes, for eight or ten doses, and then continued at longer intervals, will often mitigate this kind of headache and in a few hours remove it. In the **gastric catarrh of alcoholics**, tincture of nux vomica is frequently of value when combined with 5 to 10 minims (0.3 to 0.6 c.c.) of tincture of capsicum. The mineral acids may also be advantageously given with it. In the **gastric irritability following acute alcoholism**, a combination of nux vomica with sodium bicarbonate is useful.

In **gastric and intestinal fermentation** the following formula has been advised by W. H. Thomson:—

℞ *Resorcinolis* ʒiij (12 Gm.).
Tincturæ nucis
vomicæ f̄iiv (16 c.c.).
Syrupi zingiberis ... f̄iij (60 c.c.).
Aquæ menthæ piper-
itæq. s. ad f̄viiij (250 c.c.).

M. Sig.: Two teaspoonfuls in water one-half hour after meals.

Flatulence and **pyrosis** frequently yield to small doses of *nux vomica* tincture, given three or four times a day.

In **catarrhal stomatitis** and in the after-treatment of **ulcerative stomatitis**, the use of *nux vomica* has been recommended.

In **atonic conditions** of the bowels with **constipation**, strychnine or *nux vomica* are of value to improve the tone of the centers governing peristalsis, and in many instances also tend to relieve constipation by their action in improving the gastric functions. Strychnine is frequently used to assist and facilitate the action of laxatives. Thus, the official *Pilulæ laxativæ compositæ* (compound laxative pills) contain, in addition to aloin, extract of belladonna leaves, and powdered ipecac and licorice, $\frac{1}{128}$ grain (0.0005 Gm.) of strychnine. Fluidextract of *rhamnus purshiana* (cascara) and tincture of *nux vomica* form a valuable laxative combination. In **epidemic dysentery** with tympanites, the use of strychnine has also been recommended.

In the condition popularly described as **hepatic torpor**, when the stools are pale in color and have an offensive odor, showing an absence of bile; when the tongue is covered with a thick fur and the patient complains of headache, lassitude, loss of appetite, and a bad taste in the mouth, small doses ($\frac{1}{60}$ grain—0.001 Gm.) of strychnine given two or three times daily will often act well as a mercurial.

In **acute catarrhal jaundice**, small doses of tincture of *nux vomica* in essence of pepsin may be given with advantage (Elsner).

Certain chronic skin affections, in-

cluding **acne**, are often benefited through the effects of *nux vomica* or strychnine on the alimentary tract.

As a direct stimulant to the activity of the spinal cord, strychnine is of value in certain forms of **paralysis**, *e.g.*, those due to **alcohol**, **lead**, **pressure** on nerve-trunks, and the toxin of **diphtheria**, but only where the acute inflammation of the nerve-cells or their processes has subsided. During the earlier stage of active inflammation it is, on the contrary, harmful. Its field of use lies simply in stimulation of the activity of cells the function of which has remained depressed through the effects of the acute disease. Where there is a tendency to atrophy of the muscles supplied by the affected nerves, strychnine antagonizes it, especially if used in conjunction with massage, passive movements, and electric treatment. Unusually large doses of the alkaloid, ascending to $\frac{1}{2}$ grain (0.03 Gm.) a day, as advised originally by Hammond, are not infrequently administered in these conditions, with benefit. **Tabes dorsalis** is among the states in which ascending doses of strychnine have been employed with asserted benefit, but many deny its value except as a general tonic. In **asthenic bulbar paralysis**, very small doses of strychnine are alone indicated. In **chronic ophthalmoplegia** Grinker recommends a course of strychnine in ascending dosage. In **neuritis** and **multiple neuritis** the general tonic effects of the drug are of value; likewise in some cases of **neurasthenia**. In **epidemic poliomyelitis** and **herpes zoster**, strychnine is of value only in the after-treatment.

By subcutaneous injection strychnine has a remarkable action in

overcoming the paralysis of the bladder accompanying advanced stages of progressive paralysis. The author gave from 4 to 12 injections, each of 0.02 c.c. of a 1:1000 solution, commencing at the first sign of a tendency to retention of urine, and suspending the drug as the tendency subsided, returning to it again on renewal of symptoms. In 32 cases the rapid and certain success of the injections was amply demonstrated. The strychnine seemed to have a supplementary beneficial action in warding off or hastening the healing of decubital ulcers. Taddei (Policlinico, Jan. 19, 1913).

In brain lesions resulting in loss of power in one or more extremities, strychnine may be employed to maintain the nutrition of the paralyzed limbs. In hemiplegia, when nerve degeneration has not yet set in and the paralyzed muscles are not completely relaxed, strychnine is an efficient remedy. It is of no avail, however, when electric contractility has been lost, or, in very recent cases, in which it may do distinct harm. Any tendency to spasticity in nervous affections contraindicates strychnine.

Hypodermic use of strychnine sulphate has a good local effect and is of temporary benefit in cases with paralyzed muscles. Some patients require five to ten times the usual dose: $\frac{1}{4}$ grain (0.016 Gm.) is about the proper amount where paralysis is complete.

In a case of acute transverse myelitis, with paralysis of one leg from the hip down, $\frac{1}{20}$ grain (0.003 Gm.) and later $\frac{1}{10}$ grain (0.006 Gm.) of strychnine sulphate was injected in the paralyzed muscles daily for many days, with the result that the patient was enabled to walk.

A second case was one of apoplexy followed by hemiplegia of the left side. Fourteen days after the stroke

commenced, hypodermic injections of strychnine sulphate were given, using $\frac{1}{20}$ grain (0.003 Gm.) tablets twice a day, and running the dose up to $\frac{1}{10}$ grain (0.006 Gm.) on the third day, and finally to four tablets twice a day, or $\frac{8}{20}$ grain (0.026 Gm.) per day, which treatment was continued for eight days. The patient gained rapidly in every way, and eight weeks after the attack was walking with a cane, though he could not move the fingers. W. G. Steele (N. Y. State Jour. of Med., Oct., 1908).

In incontinence of urine or feces, due to lowered activity of the lumbar spinal centers governing the sphincter muscles, strychnine is at times of considerable value. The nocturnal enuresis of children, when not relieved by belladonna, ergot, and iron, may be benefited by nux vomica.

In diabetes insipidus, strychnine has at times been found of value. As a stimulant to the sexual center in the spinal cord, strychnine may be used in cases of impotence not due to pronounced organic lesions.

In amblyopia due to tobacco, alcohol, lead, arsenic, and other drugs, as well as in some forms of optic neuritis, strychnine given hypodermically in ascending doses is of some value in preventing blindness or accelerating recovery. Beginning with $\frac{1}{40}$ grain (0.0015 Gm.) the dose may be gradually increased to $\frac{1}{8}$ or $\frac{1}{6}$ grain (0.008 or 0.01 Gm.). De Schweinitz in these cases advises ascending doses of the tincture of nux vomica, beginning with 3 drops three times daily until physiological effects are apparent; in some instances 60 drops in the twenty-four hours may be reached.

Where there is weakness of the extraocular muscles, with or without actual strabismus, and with eye-strain

dependent thereupon, *nux vomica* or strychnine does much good by improving the tone of the nerve-centers from which these muscles are innervated. Sometimes in **incipient cataract** strychnine will slow the development of the opacity in the crystalline lens.

Strychnine has at times proven efficient in various forms of **neuralgia**, especially those affecting the viscera (**gastralgia**, **hepatalgia**, etc.), and also in **infraorbital neuralgia**. The **neuralgic** form of **dysmenorrhea** is sometimes relieved by the administration

of *nux vomica* during the intermenstrual intervals. In **amenorrhea** the tonic action of *nux vomica* on the pelvic viscera not infrequently affords an indication for the use of this remedy. Barker's formula for **post-partum hemorrhage** is: Tincture of *nux vomica*, 20 drops; fluidextract of ergot, 30 drops; to be given, and repeated if necessary, until the uterus is well contracted.

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O

OBESITY.—DEFINITION.—

An abnormal accumulation of fat in the subcutaneous and other tissues, due to deficient oxidation of fats formed from ingested starches and fats and also, though less actively, from ingested proteins.

SYMPTOMS AND PATHOGENESIS.—The problem has assumed various new aspects in recent years owing to the addition, to our working field, of organs—the ductless glands—which were formerly disregarded. Some of these structures are concerned with general metabolism to such a degree that to study obesity without taking them into account entails the danger of grave diagnostic errors.

In the light of modern research, obesity should be divided into several forms each of which will be reviewed separately, insofar as symptomatology and pathogenesis are concerned.

Common Obesity (Lipomatosis Universalis).—In this, the most wide-

spread form of obesity, a diffuse, relatively even distribution of the fatty deposit throughout the various parts of the body is generally a striking feature. The severity of the condition, however, varies within wide limits. To the simple fatty accumulation commonly observed in men of advancing years, with increased abdominal circumference as the chief manifestation, the term obesity, or lipomatosis, is scarcely applicable in its strict sense, for true obesity is an abnormal state and the condition of the group of stout individuals referred to cannot be definitely stated to be abnormal. At the opposite extreme stand those cases of general fatty accumulation so marked as to be a constant source of comment on the part of passers-by and of danger to the individual himself through overburdening of the heart, with the possibility of sudden failure of its function.

The most superficial and obvious

division of cases of common obesity is that based upon the apparent general condition of health of the individual. In popular terms the distinction is thus made between "good fat" and "bad fat," the first designating the type of obesity in which the subject is vigorous and of florid, healthy appearance, while the second relates to patients with an anemic, rundown aspect, in whom the obesity has given rise itself to, or become otherwise associated with, complications implying injury to visceral organs or deviations from the normal processes of tissue consumption and repair. In the "healthy" *florid type* of obesity the increase in weight is due merely to the actual deposits of fat in the body, and the circulation is as yet but slightly or not at all impaired. The "unhealthy" or complicated type is the natural sequel of the previous form if it be sufficiently marked and persistent; not only is the patient pale, weak, and cachectic, the so-called *anemic type*, but there is commonly an excess of water in the tissues in addition to the fat.

Another grouping of cases of obesity termed *alimentary obesity* is that based upon the amounts of food and of outdoor physical exercise taken. Where the quantity of food ingested is unusually large, or is merely large in comparison with the amount of physical work performed, a condition arises in which the income of absorbed food material is considerably greater than the amount used up in setting free the energy required in muscular activity, and excessive storage, not only of fats, but also in some degree of carbohydrates, takes place. The condition resulting in such cases is termed *alimentary obesity*. In other cases,

on the other hand, where the increase in body weight has not been due to overnutrition, but has occurred for some other reason, and shows a tendency to persist in spite of a reduction of the food intake below normal and an increase in the amount of physical exercise taken, the condition is designated *constitutional obesity*.

While the deposition of fat in common obesity may give rise to no symptoms other than obvious enlargement of the body, or inconvenience in locomotion, etc., there appear, when the obesity reaches certain limits, evidences of interference with the functions of various organs: dyspnea, especially on exertion, due to embarrassed cardiac action (fatty degeneration or fatty overgrowth, *q. v.*, in the fifth volume, see Index, and its complications, passive pulmonary congestion, cyanosis, edema, etc.

Obesity does not necessarily produce a weak heart, cardiac inefficiency, or high blood-pressure, but it predisposes the heart to these disorders. The inactivity it engenders, dietary indiscretions, and the evident disproportion between cardiac size and body size sum up a total that overloads a heart. These patients accumulate a fatty cardiac capsule which once formed is very hard to get rid of. Beside this the muscle of the cardia is infiltrated with fat and this produces a weakness and loss of tone. Norman (New York Med. Jour., Mar. 30, 1918).

The digestion is often impaired, the liver enlarged, and constipation is common. Both gout and diabetes are frequently observed in the obese who also show a predilection to infection owing to their low resistance to bacterial infection. In obese females, sterility and amenorrhea are commonly noted.

An obesity of 100 kg. (224 lbs.) or more is usually accompanied by some pathologic condition, usually asystole and uremia, diabetes, gout and lithiasis. But 4 out of 43 cases showed simple plethora. The blood pressure and viscosity were almost invariably above normal. The parallelism was striking between the weight, pressure and pulse in 3 cases. Treatment must be individualized accordingly. Martinet (*Presse méd.*, Jan. 22, 1921).

Adiposis Tuberosa Simplex.—This form of obesity, first described by James M. Anders, of Philadelphia, is characterized by the formation of circumscribed fat masses in the subcutaneous tissues. These masses are moderately dense, slightly movable, somewhat flat, and range in size from a bean to that of a hen's egg. They vary from a dozen to two dozen or more, are confined to the extremities, especially the lower, in some; in others occur on the abdomen. They are sensitive to the touch and may be the seat of pain. The *mammæ* and abdominal panniculus adiposis may overhang. It is uncommon, Anders having observed it in only 4 out of 324 cases of obesity.

Adiposis Dolorosa.—This disease, first described by Dercum, of Philadelphia, consists in the irregular deposition of masses of fat in the subcutaneous tissues. These masses are painful to the touch and the seat of spontaneous pain. Dercum's disease has been described in full in the first volume (see ADIPOSIS DOLOROSA).

The Obesity of Hypothyroidism.—The close connection between the thyroid and general metabolism has been reviewed under "Thyroid" in the article on ANIMAL EXTRACTS in the first volume. Briefly, its influence on the growth and metabolism and of

the functional activities is well illustrated by the remedial use of thyroid gland in cretinism. In myxedema a more or less rapid loss of weight is noted. A number of investigators have found that this was accompanied by an increase of the nitrogen excreted with the urine. While the oxygen intake was greatly increased—almost doubled at times—the carbon dioxide excretion was greatly increased. Normal individuals have likewise been found to utilize more oxygen and excrete more carbon dioxide under the influence of thyroid medication. All these biological phenomena return to normal as soon as its use ceases. The body fats have been found to be first used up, then the proteins, until then spared to a marked degree, are attacked.

How does thyroid produce these effects? This point has not been finally determined. The only theory before us at the present time is my own, advanced in 1907, viz., that the thyroid sensitizes the nucleins of the tissue-cells, including those of the nuclei of fat-cells, to oxidation, the process corresponding with that through which Wright's opsonins render bacteria vulnerable to the phagocytes.

From my viewpoint, then, it is not by a direct action on the tissues that the thyroid secretion or therapeutic agents produce their effects, but by urging them, as catalyzer probably, to be oxidized more easily. It renders the nuclear phosphorus more inflammable as it were. This accounts not only for the increased intake of oxygen referred to above, but also for the large increase in the phosphoric acid excreted recorded by Chittenden and others.

Not only is the nervous system, but the processes of oxidation are powerfully influenced by the blood-glands. After thyroidectomy, or in myxedema, oxidation is diminished (Magnus-Levy). In Graves's disease, on the contrary, and after thyroid medication, as found by the same author and by Mattes, and previously by Vermehren, oxidation is increased. Oxidation is likewise diminished after castration (Loewy and Richter); the administration of testicular extract to the castrated dog, however, increases oxidation, and still more does ovarian extract in the castrated male dog, while ovarian extract, of course, effects an increase of oxidation in the spayed bitch. Arnold Lorand (*Monthly Cyclo. and Med. Bull.*, Aug., 1906).

Thyroid obesity, then, is that form in which the organ fails more or less to sensitize adequately the tissue nucleins. Hydrocarbons then accumulate in various regions in the form of fats. These cases can easily be detected as a rule; besides their obesity, they present more or less marked stigmata of hypothyroidism—often confused with the anemic type.

There are two well-defined forms of obesity: that due to overfeeding in proportion to exercise, and that due to the influence of the thyroid. In the first form there is normal power of oxidation, but the disproportion between the intake and outgo causes obesity, either from excessive eating or lack of exercise, or combination of both. In the thyrogenous form the power of oxidation is reduced, although the relation between intake and exercise may correspond to normal.

The thyroid influence may be primary or secondary, hypofunctioning of the thyroid being the result of distant action from other organs, the pancreas, the ovaries, hypophysis, suprarenals, or thymus. C. von Noorden (*Med. Klinik*, Jan. 3, 1909).

The Obesity of Hyperadrenalism.—

The adrenals produce obesity in precisely the opposite way. Although I believe that these organs are instrumental to a material degree in producing the form commonly observed in plethoric subjects and due to the excessive ingestion of food, owing to the abnormal activity to which they are continuously subjected, those cases will only be considered here in which an absolute connection is known to exist between the adrenals and lipomatosis. Thus, while we know that destruction of the adrenals brings on Addison's disease in which asthenia and decreased nutrition are the preponderating phenomena, we have precisely the opposite condition in malignant hypernephroma of the adrenals in which there is exuberance of adrenal tissue. Here, besides the obesity which attains in some instances museum-freak proportions, there is every evidence of exaggerated metabolism. Children suffering from this disease may become twice or three times taller than is normal at the corresponding age. There is abundant growth of hair and the genitalia may be as fully developed as those of an adult, though the child be perhaps but 6 or 7 years old.

How explain this form of obesity with the prevailing conception of the functions of the adrenals as the only foundation? Textbooks of physiology teach that the adrenal secretion raises the blood-pressure and increases the power of cardiac contractions, while slowing the heart; and, moreover, that it governs the sugar content of the blood, thus influencing carbohydrate metabolism. That these functions, though well grounded, fail to explain the morbid process described,

particularly the marked overgrowth and lipomatosis, is obvious.

All tissue, bones, muscles, nerves, etc., undergo excessive development; and, inasmuch as the adrenal secretion or extractives raise the temperature, increase the oxygen intake, the carbon-dioxide output, and awaken other phenomena which are always taken as evidences of increased oxidation, we cannot escape the conclusion that the adrenals are deeply concerned with general metabolism. In 1903 I advanced the view that the adrenal secretion took up the oxygen of the air in the lungs, and then became that part of the hemoglobin molecule which served to sustain tissue oxidation. This being accepted, the connection of a great excess of adrenal secretion such as is produced in hypernephroma and the obesity produced become intelligible. We are dealing with an *exaggerated upbuilding process*. The appetite and thirst are excessive in these cases, and the entire organism is developed two, three, and even four times as rapidly as it should be, judging from reported cases.

[A distinction must be clearly apprehended in this connection between the influence of the adrenals on adiposity and that of the thyroid on the same process. While the adrenals produce it through exaggerated functional activity, the thyroid brings it about through diminished functional activity. The former is an active upbuilding process, while the latter is a passive accumulation of substances which would be adequately used up were the thyroid functionally efficient. The importance of this fact asserts itself when the treatment of these cases is in order. It is obvious that while thyroid gland would prove useful in a case of obesity due to hypothyroidia, the same treatment, by activating metabolism in a case of hypernephroma or its benign homologue, ple-

thoric obesity, would prove harmful by enhancing metabolism. C. E. DE M. S.]

The Obesity of Castration.—As specified elsewhere, I do not believe that the organs which produce an internal secretion are as numerous as is generally believed; the thyroid and the adrenals are true internal secretion glands, from my viewpoint, however, in the sense that their hormones are of use as such throughout the body at large. In this class I do not include the ovaries or testes, but regard these organs as the source of what I have termed an "autonomous secretion" which means that it is intended only to influence those structures or organs which form part of the mechanism to which the secreting gland belongs, the genital mechanism in the present instance.

This view would not seem to account for the familiar phenomena that follow castration or oöphorectomy, but it does so better than the prevailing doctrine, which offers no explanation. From my viewpoint, the testicles and ovaries *partly* build up their autonomous secretion from adrenal and possibly other as yet unknown substances; they then utilize what portion of this synthetic secretion is needed for the specific function of the sexual apparatus, with which their secretion is concerned: menstruation, semen formation, and pregnancy, for instance, then return the *unused surplus* to the organism at large. As stated, these organs are only supplied partly from the system at large; there is much chemical and pharmacological evidence to show that besides building up nucleins,—those constituting the heads of spermatozoa, for example,—some of their tissues belong to the chromaffin sys-

tem, and that they are thus able to create themselves a true adrenal secretion to contribute to and enhance when need be,—as during the uterine development of pregnancy, for example,—local metabolism. Accordingly, what they contribute to the organism at large is not wholly unused material borrowed from it, but also substances which, though similar to those found throughout the whole organism, are part of the general asset in those substances.

The effects of oöphorectomy or castration now suggest themselves. We have seen that—from my viewpoint—the thyroid and adrenal secretions and the nucleins are active participants in general metabolism. Removal of the testes or ovaries thus means deprivation on the part of the general organism of a portion of the substances necessary to its cellular exchanges, which means the vital process itself. In the young these operations inhibit the development of what remains of the genital organs, and prevents the growth of hair; in adults, the remaining genital structures atrophy and more or less obesity results.

The obesity following castration or oöphorectomy thus finds its explanation in a general slowing of the tissue interchanges, owing to deficient oxidation, through loss of what adrenal secretion and nucleins the removed organs would have contributed to the body at large under normal conditions.

Obesity Due to Lesions of the Pituitary.—The foregoing statements have prepared the way for an analysis of the forms of obesity due to lesions of the pituitary body. The word “forms” is employed in this connec-

tion because, interpreted from my viewpoint, both the Fröhlich syndrome—the more important of the clinical symptom-groups of this class—and Dercum’s adiposis dolorosa are due to lesions of this organ—though these lesions are quite dissimilar insofar as their location in the organ itself or the peripheral tissues are concerned. To convey clearly the manner in which obesity is produced, a brief survey of my interpretation of the functions of the pituitary is necessary.

I held, over a decade ago, that the pituitary was not, as is generally believed, a secreting gland. It is composed of two parts: (1) a glandular or spongy portion composing the anterior lobe, and (2) a nervous portion, the posterior lobe, which includes a layer, the pars intermedia, that separates it from, but is in juxtaposition with, the anterior lobe. It is this pars intermedia which is said to produce the secretion that extracts of the posterior lobe, or the active material obtained from it, are supposed to represent. Now, the weakness of the view that the pituitary is a secreting gland is shown by the fact that the only glandular portion of the organ, the anterior lobe, the structure of which alone suggests such a function, produces extracts which are inert, as first shown by Howell, while the structure which produces active extracts is a nervous organ presenting no secretory characteristics and connected directly with the brain. The colloid masses supposed by Thaon, Herring, Cushing, and others to be secretory products are present in the inert anterior lobe, but not in the active posterior lobe, according to Grünbaum. Indeed, there is ground

for the belief, to which Halsted has recently added testimony, that the colloid found in large quantities in relatively inactive thyroids is an inert substance and not a secretion at all, its presence in the inert anterior lobe being additional proof of this fact.

It is thus apparent that while the anterior lobe has none of the pharmacological attributes of a secreting organ,

[Though resembling histologically a gland, the posterior lobe to which the pars intermedia belongs has no claim whatsoever to be regarded as such. Indeed, as stated by Swale Vincent in reference to this lobe, "it is extremely difficult to imagine how such a structure can be regarded as a secreting gland." Finally, were the pituitary body the source of an internal secretion necessary to the well-being of the organism at large, a true hormone, the organ could not be removed, when diseased, as it has been in numerous instances by Hochenegg, von Eiselsberg, Cushing and others, without, as is the case with *bona fide* ductless glands, the thyroid and adrenals for instance, compromising life. That this does not follow the operation—even though death follow the removal of a normal pituitary—is readily explained if, with me, the organ is regarded only as a co-ordinating center with subsidiary centers, including probably the pineal, in the cerebrospinal axis, that are capable of taking up, *even though imperfectly*, its functions as chief center when it becomes diseased.

As to the functions which the pituitary co-ordinates, I will merely, in the present connection, recall that I have long held that this organ governed, by way of the spinal axis, as stated above, the functions of the sympathetic system, and through this system and among other organs, the thyroid and adrenals. This view has been combated, but by no means with convincing facts, and the day is not far off when its strength will surely assert itself. C. E. DE M. S.]

Granting, then, that the pituitary body governs the functions of the

thyroid and adrenals, we gain an insight into the, at present obscure, pathogenesis of the two conditions in which obesity is a prominent feature, Fröhlich's syndrome.

Fröhlich's *dystrophia adiposogenitalis*, in the light of the foregoing facts, becomes the symptom-complex of deficient activity of both the thyroid and adrenals as a result of destructive or inhibitive disease of the pituitary body or of its efferent channels. Besides the symptoms, headache, hemianopsia, etc., which in progressive cases are due to pressure by the diseased pituitary body, etc., the phenomena denoting thyroid insufficiency are often very clearly defined. Thus, besides the obesity, which may be very marked, the tissues may become myxedematous, hard and tense to the touch; infantilism is a prominent feature in most young subjects and the rheumatoid pains of hypothyroidism are not infrequent. The menstruation is irregular or inhibited, though metrorrhagia is sometimes witnessed. The intelligence is dulled and mental disturbances are frequently noted. The patients are potbellied and moon-faced. In a case personally observed in the course of a lawsuit, several physicians had given a diagnosis of myxedema under oath, so marked were the phenomena of hypothyroidism.

The symptoms of insufficiency of the adrenals are no less prominent. We have seen that excessive activity of these organs gives rise to premature development of the genital organs and excessive growth of hair. In the deficiency of adrenal activity which from my viewpoint occurs in Fröhlich's disease, we have opposite conditions: the genital organs remain

infantile while there is absence of hair in the pudendal and axillary regions. Cases developed after puberty show hypothermia and progressive loss of hair and of sexual characteristics, besides the symptoms of hypothyroidia enumerated.

[The laboratory has confirmed the teachings of the clinic. Crowe, Cushing and Homans found that the animals which recovered after removal of the pituitary, showed disturbances similar to those noted in man; they became obese, sexually impotent, mentally abnormal, and showed evidences of disturbed cutaneous nutrition, atrophy of the genital organs, disordered carbohydrate metabolism, and a lowered temperature—all phenomena markedly influenced, we have seen, by the adrenals.

A feature upon which I wish to lay some stress in this connection is, that while fully developed cases of Fröhlich's adipogenital syndromes are relatively rare, many of the fat, moon-faced and large-limbed children commonly observed are examples of a larval type of the disease which, though not progressive, as are the cases due to malignant growths of the pituitary or of its surrounding structures, may nevertheless permanently impair the child's mentality and sexual attributes. Such cases are usually due to lesions of the pituitary produced in the course of some infection, a part of the organ becoming sclerotic. Several microphotographs in my work on the Internal Secretions illustrate such lesions as produced by alcohol, ricin, etc. Such children, though stout, are apt to be pale, anemic and mentally backward, the genital organs and their hairy covering developing late. Identified in time, such children are greatly benefited by treatment. C. E. DE M. S.]

Another feature which merits emphasis is that, in the light of my views, *i.e.*, with deficient thyroid and adrenal activity as the foundation of Fröhlich's syndrome, the lesion need not be located in the pituitary itself, as already mentioned, but anywhere along the path of the fibers it sends

via its infundibulum, the basal tissues, the bulb, etc., and the sympathetic or autonomic system to the thyroid and adrenals. They explain why tumors located almost anywhere in the base of the brain may cause the disease.

Aberrant types of Fröhlich's syndrome, including its obesity, are frequent; but if we recall that the presence of a tumor in the pituitary may excite it to inordinate activity at first, the presence of acromegaly, for instance, with symptoms of hyperthyroidism and hyperadrenism in some cases, followed ultimately, as a result of advanced lesions, by hypothyroidism and hypoadrenism, *i.e.*, the typical Fröhlich syndrome.

ETIOLOGY.—The statistics of Bouchard, Kisch, Chambers, and Oulmont and Ramond averaged, tend to show that 52 per cent. of obese individuals are the offspring of obese parents. J. M. Anders places it as high as 60.7 per cent., with several generations, as the basis of his inquiry. To this predisposing cause may be added the gouty or arthritic diathesis, so-called, and the manifestations of the latter, asthma, lithiasis, eczema, migraine, etc., all conditions in which oxidation is slowed. While the inherited type tends to develop in the young, there is a general tendency toward adiposity after about the thirty-fifth year in women and after the fortieth in men. Females, owing mainly to greater indolence, the puerperium and the menopause, are predisposed to obesity to a much greater degree than males.

Persistent obesity in children should be looked upon with suspicion, lest an infectious disease, by causing lesions of one or more of the ductless

glands, have brought on one of the special types attributed to these organs and described under the preceding heading.

Excessive alimentation in a normal subject tends to produce obesity when the diet is mainly composed of carbohydrates: bread, potatoes, sugars, etc., and fats, although albuminoids are also fat-producing foods, though to a lesser degree.

The experiments of Genth and Robin, and particularly those of Hawk of Philadelphia, have shown that an excess of water during meals increased nitrogen excretion and in fact that of all urinary salts. This was obviously due to a washing out of the tissues, as it were, since the increase of excretory products was only temporary. If the kidneys are the seat of some disorder which inhibits their function, fictitious obesity may occur through accumulation of water in the tissues along with the chlorides.

Alcohol differs in its effects according to the manner in which it is used. Concentrated, as it is in whisky, brandy, etc., it tends more to cause emaciation than obesity, owing to the fact that it then promotes oxidation by stimulation. If indulged in to excess it gives rise to lesions in various organs, particularly the liver, and in this way produces emaciation.

Atwater holds that alcohol spares fats by being oxidized in lieu of the latter, but Leven found that when alcohol was replaced by another agent as readily oxidized as alcohol fats were not spared.

Diluted alcohol such as beers, wines, etc., do not interfere with assimilation, and may, in fact, enhance it, unless taken in excessive quantities. Obesity is thus favored.

In women particularly castration is an important cause of obesity owing to the premature menopause induced. This does not always apply as regards the male sex, many eunuchs being tall and thin, a fact also illustrated by spayed horses. Indolence in such, however, will be followed by obesity, the tendency being toward slowed tissue oxidation and catabolism. Lactation also tends to favor the development of obesity.

Obesity may follow typhoid fever, pneumonia, pleurisy, measles, and pertussis, or occur in subjects exposed, in the course of their daily occupations, to poisoning by lead, phosphorus, or arsenic. Very minute doses of these toxics and also of morphine, strychnine, tubercle toxins, and diphtheria toxins given to guinea-pigs along with their food, cause these animals to increase in weight, sometimes very markedly and rapidly.

Cases traceable to persistent though slight hemorrhages, as in recurrent epistaxis and metrorrhagia, are not infrequent. Cattlemen in some parts of Europe subject cattle to occasional bleedings to increase their market weight. Vulpian and Dechambre have observed the same effect experimentally in dogs. Anemia and chlorosis are familiar causes of obesity, doubtless due in such cases to the deficient oxidation incident upon the loss of hemoglobin.

A sedentary life predisposes to corpulency owing to the slowed oxidation resulting from deficient muscular activity. Rest-loving and phlegmatic individuals, and the inhabitants of tropical countries in which the climate almost imposes indolence are often obese.

Emotions and traumatisms have

also been found to precede the development of corpulency. In such cases there is usually a predisposition to the disorder through heredity or some constitutional disorders, as gout, in which tissue metabolism is slowed.

PATHOLOGY.—In the average adequately nourished individual fat accounts for about one-twentieth of the total body weight. In the female the proportion is even somewhat larger. The amount may be considerably larger, however, without being an indication of impaired health, fat constituting as much as one-thirteenth of the body weight in not a few instances. Thus, in an individual weighing 160 pounds, 8 to 12 pounds of this weight will consist of fat.

The fat is not, as might be supposed, deposited exclusively beneath the skin, but occurs also in appreciable amounts in numerous less superficial localities, notably in the omental appendages in the abdominal cavity, the mesentery, or sling by which the intestines are suspended from the posterior wall of the abdomen, the marrow of bones, the spaces behind the eyeballs in the bony orbits, the tissues surrounding the kidneys, the layer of tissue beneath the pericardium, as well as some tissues in the neighborhood of joints. In but few localities, *e.g.*, in the lungs, in the interior of the skull, and in the tissues immediately beneath the skin where the latter is very thin, as in eyelids and certain portions of the external genitals, is fat constantly absent.

The tissue in which fat is chiefly deposited, commonly termed "adipose tissue," is in reality a modified form of connective or supporting tissue, the cells constituting the latter, pre-

viously flattened or spindle shaped, becoming gradually distended with clear, oily fat, and being then termed "fat-cells." Fat-cells in their earlier stages of development thus present the aspect of a signet ring, the nucleus of the original connective-tissue cell forming a rounded knob on one side, while the protoplasm or remaining material of the cell forms a narrow even band around the accumulating mass of fat. In the adult fat-cell, on the other hand, the protoplasmic ring has become so thin as to be frequently invisible, except in the vicinity of the now more or less flattened nucleus, the cell as a whole appearing essentially as a large, clear globule sharply marked off by the limiting cell membrane. Well-distended fat-cells measure about 0.02 mm. ($\frac{1}{1250}$ inch) in diameter, *i.e.*, are about three times as large across as the ordinary red blood-cell. The fat-cells are for the most part in immediate mutual contact, but are disposed in groups separated by layers of unmodified connective-tissue cells, which tend to support and impart firmness to the fatty accumulation as a whole. Where fat exists in considerable masses the individual cells assume a polyhedral rather than spherical form, owing to mutual pressure, and the groups of cells appear to the naked eye, when the fatty tissue is cut into, as yellowish, granular bodies. In the connective tissue separating the lobular aggregations of fat-cells run the numerous fine blood-vessels required as avenues of nutritive supply to and outlet from the fatty deposits. Where, by reason of starvation, the fat-cells are relieved of their reserves of fat, they are in most instances capable of returning to their original condition

as ordinary connective-tissue cells. In certain aggregations of cells, however, the so-called "fat organs" of Toldt, this property is in abeyance, the cells being more strictly fat preservers than the common variety, and yielding their contents only under circumstances of the utmost necessity.

The writer has found the parotid gland symmetrically enlarged in 33 obese male patients; in 18 the mammary glands also showed considerable enlargement. He never found this hypertrophy of the parotid gland in persons whose corpulence was general and merely a sign of being unusually well nourished. The parotid enlargement belongs to the type of true obesity in which the fat alone is present in undue amounts, and is mostly restricted to the face, breast; and abdomen, while the arms and legs appear almost lean. Sprinzels (Wiener. klin. Woch., Nov. 28, 1912).

The sugar content of the blood was found decidedly above normal in 4 of 16 obese patients examined. Alimentary glycosuria followed ingestion of 100 Gm. of dextrose in only 3 of the 4 cases, but determination of the sugar content of the blood revealed latent diabetes in all the cases. Restriction of the intake of carbohydrates was soon followed by marked improvement. Bang's method for determining excess of sugar in the blood is simple and reliable.

When hyperglycemia is thus ascertained, an antidiabetic diet will not only tend to ward off further trouble from the underlying diabetes, but it will tend to cure the obesity. Hyperglycemia is liable to predispose to arteriosclerosis, contracted kidney, cerebral hemorrhage, cataract, eczema, furunculosis and gangrene; one should get on its track early, and check it by an appropriate diet. Roth (Jour. Amer. Med. Assoc., from Berl. klin. Woch., May 18, 1914).

TREATMENT.—The cause should, of course, be carefully ascertained,

and treatment regulated accordingly. The medicinal treatment of obesity, other than **organic products** in carefully selected cases, is practically useless. Main dependence, in fact, should be placed upon **diet and exercise**.

Experience shows that usually children with early inherited obesity develop diabetes before 40. This occurs in only about 50 per cent. when the inherited obesity does not develop till late, and in only 15 per cent. when the obesity is acquired. After puberty, if the obesity declines, the outlook is favorable, at least to 35 or 40. But if the *endocrine glands* show insufficiency, progressive dystrophy may be anticipated. Obesity in the parents should be combated; especially during pregnancy the diet should be supervised. Organotherapy is indicated in certain cases. Thus, a girl at puberty threatened with the adiposogenital syndrome may be given **thyroid, ovarian and pituitary gland** in turn for 10 days each, or the 3 may be combined. Or **potassium iodid** might be given for 10 days each month (10 or 20 cg.—1½ to 3 grains—daily). G. Mouriquand (Lyon méd., Nov. 10, 1920).

Diet.—A principle which will be found to apply to most cases of obesity, *e.g.*, those in which some trouble of the ductless glands or some other organic disorder does not exist, is briefly as follows: An obese subject who about maintains a normal balance as to weight on a normal diet can stand a certain reduction in his fare, but if this limit is exceeded cardiac complications will appear. The limit, which varies in each case, cannot, therefore, be gauged by calories. The heart should therefore be watched, lest tachycardia occur, and treatment begun by reducing by one-half the fats and starches, especially flour, potatoes, and beans usually taken.

The writer's method is based on study of the individual organic interchanges, especially the respiratory interchanges. Five small meals are allowed with a walk immediately after the first three, of half an hour at least, avoiding sauces and all beverages except very weak tea. The lunch, at 11 A.M., of one or two soft-boiled eggs and a little bread, followed by a walk, prevents the patient's being very hungry for the midday meal; the large cup of very weak tea, at 5 P.M., and a cracker also reduce the appetite for dinner. He has the twenty-four hours' urine measured; if the amount increases under this *régime* the outlook is very encouraging. If it does not increase, more fluids should be ingested. The obese patient eating in this way will not feel the restrictions irksome, but the total of calories is much below the physiological amount for the weight. M. de Fleury (Bull. de l'Acad. de Méd., April 25, 1911).

In the treatment of obesity, far more than under normal conditions, it is necessary for the food to contain a natural surplus of inorganic bases over inorganic acids. Unless this is the case the patient's resisting powers will be materially reduced, the heart and circulation suffering most. A surplus of bases is found in fruits, nuts, milk, etc.; a surplus of acids is found in meat, bread, beans, etc.; 100 Gm. of the acid-carriers require 200 or 300 Gm. of the base-carriers to balance. These fundamental laws must be taken into account in treatment of obesity, at least, or the patient's heart and general health will suffer materially. Berkner and Berg (Zeit. f. klin. Med., lxxvii, Nu. 5, 6, 1913).

If the patient fails to lose weight in two weeks, then **butter, milk, fats** in general, should be forbidden and **exercise** over and above that usually taken ordered. If he habitually walks about one mile, he should gradually increase the distance—which should

be established by the attending physician according to the needs of each case—until five miles are walked briskly each day. These simple measures are often sufficient, if persisted in, to obtain good results.

Muscular exercise for the purpose of accelerating oxidation is only slightly less important than an appropriate diet; it promotes destruction of the fat already warehoused in the system, and invigorates both the circulation and the respiration. The particular form of exercise and its duration must be adapted to individual cases, and special care must be observed in cases manifesting feebleness of circulation. The writer's best results have followed from open-air walks, combined with gymnastics for the arms and trunk. The distance taken should not be less than three to four miles daily, and should be measured by the use of a good pedometer. In the plethoric type this distance may soon be taken on inclines of moderate degree.

In cases of *anemic type*, however, the patient must begin with short walks on the level, to be increased by easy stages as the cardiac and general strength of the patient permits. Later a like plan is to be pursued with regard to the degree of inclination, the object being to invigorate the heart muscle and improve oxidation. If cardiac dilatation is present the **Schott "resistance exercises"** may be employed. Great care must be exercised in cases in which atheromatous vessels are found. Persons afflicted with the *hydremic type* are often lethargic and averse to using physical exercise. In such patients, deep **massage** and **Swedish movements** are the best substitute, and promote protein decomposition as well as elimination. J. M. Anders (N. Y. Med. Jour., July 4, 1914).

Reduction of the quantity of food ingested to normal limits is, of course, indicated in individuals who eat excessively, either at the regular meals

or by eating between meals or the now fashionable "midnight supper." Careful mastication is of major importance.

In some patients the evening meal is the harmful one, owing to the slowed oxidation incident upon rest and sleep which follows it. A very light meal, or one or two cups of tea with a couple of slices of bread and butter, without other changes in the dietary or habits suffice in some cases to cause a gradual reduction in weight.

Von Noorden advocates small but frequently **repeated meals**, the aim being probably to insure perfect digestion of all foods, while avoiding those which promote the accumulation of fat. He orders the following diet: At 8 o'clock 80 Gm. ($2\frac{2}{3}$ ounces) of lean cold meat, 25 Gm. ($6\frac{1}{4}$ drams) of bread, 1 cup of tea, with milk and no sugar. At 10 o'clock 1 egg. At 12 o'clock 1 cup of strong broth. At 1 o'clock a small plate of meat-soup, 159 Gm. ($5\frac{1}{3}$ ounces) of lean meat, flesh or fish; 100 Gm. ($3\frac{1}{3}$ ounces) of potatoes with salad; 100 Gm. ($3\frac{1}{3}$ ounces) of fresh fruit. At 3 o'clock 1 cup of black coffee. At 4 o'clock 200 Gm. ($6\frac{1}{4}$ ounces) of fresh fruit. At 6 o'clock $\frac{1}{4}$ liter ($\frac{1}{2}$ pint) of milk with tea. At 8 o'clock 125 Gm. (4 ounces) of cold meat or 180 Gm. (6 ounces) of meat, raw and grilled, and eaten with radishes and salads; 30 Gm. (1 ounce) of graham bread, and 2 or 3 teaspoonfuls of cooked fruit with sugar.

The writer found that to disregard the calories and provide foods which were readily digested enabled him to obtain better results. An antidyspeptic diet, by insuring perfect digestion and thus avoiding irritation of the

sympathetic system and through it the ductless glands prevents the nutritional disorders provoked by the latter. Pron (Paris médical, April 26, 1913).

The dietary recommended by **von Noorden** can only be carried by persons who have no occupation. In such and with appropriate exercise it is said to be effective. In individuals who are occupied, however, the following measures are sometimes efficient. The total quantity of food ingested and the fats and starches are diminished, but the albuminoids are taken as usual. The diet is as follows: *Breakfast*: One cup of coffee with milk; bread, $2\frac{1}{2}$ ounces (75 Gm.). *Luncheon*, noon: One plate of soup, 5 ounces (150 c.c.); lean meat or fish, 2 green vegetables, lettuce; bread, 1 ounce (30 Gm.); pudding or fruit, water as beverage. *Supper*: Two eggs or meat, 3 to 4 ounces (90 to 120 Gm.); bread, 1 ounce (30 Gm.); salad; fruit; tea, 1 or 2 cups; water.

This diet is to be kept up for months, the patient being weighed every other week. When the desired weight is reached the food intake is gradually increased, beginning with the albuminous foods, but as soon as a slight increase in weight appears the diet should be slightly reduced and maintained at that point, which will represent the patient's assimilation level.

Anders recommends the following dietary, subject to slight modifications to suit individual cases: *Breakfast*: Fruit, as an orange or 2 peaches or half a grapefruit (without sugar) or a sour apple; fine wheat bread, $1\frac{1}{4}$ ounces (0.4 Gm.); a soft-boiled egg; milk, 1 ounce (30 c.c.); saccharin, $\frac{1}{2}$ grain (0.03 Gm.); coffee, $4\frac{1}{4}$ ounces (127 c.c.). *Luncheon*: Caviar, 2

drams (8 Gm.); lamb chops, sweetbread, boiled ham (cold), or fowl or game in season, 3 to 4 ounces (90 to 120 Gm.); salad, 1 ounce (30 Gm.) (with a small amount of French dressing); cheese, 1 dram (4 Gm.); bread, rye or bran, $\frac{1}{2}$ ounce (15 Gm.); fruit (except strawberries and bananas), or (instead of the latter) water, 4 ounces (120 c.c.). *Dinner:* Soup (clear), 3 ounces (90 c.c.); fish, 2 ounces (60 Gm.); roast or broiled beef, lamb, veal, or game or poultry, 4 to 5 ounces (120 to 150 Gm.); 1 or 2 of the following green vegetables: spinach, string beans, green peas, celery (stewed), asparagus, raw sliced tomatoes, Brussels sprouts, $1\frac{1}{2}$ ounces (45 Gm.). For dessert, the patient may take plain rice pudding, junket, cup custards (all slightly sweetened), or fruit (except strawberries and bananas) either raw or cooked, 4 to 5 ounces (120 to 150 Gm.). The patients may take 4 to 5 ounces (120 to 150 c.c.) of water when fruit is not used. Additionally, a glass of water on rising and three hours after each meal is to be taken, and during the warm season from 1 to 3 glasses over this amount. Thus the patient receives about 175 Gm. ($5\frac{2}{3}$ ounces) of carbohydrates and 250 Gm. ($8\frac{1}{3}$ ounces) of protein daily.

In *obesity associated with or dependent on gout*, the nitrogenous elements are reduced to about 150 Gm. (5 ounces), and 40 to 50 Gm. ($1\frac{1}{3}$ to $1\frac{2}{3}$ ounces) of fat, principally in the form of butter and cream, as well as an additional $\frac{1}{2}$ liter (pint) of water, are allowed. In general it may be said to be unwise to restrict too greatly the fluid intake in cases in which the protein materials are prescribed in excess of the usual

amounts, since it permits retention of the products of nitrogenous metabolism.

In the *anemic type*, which early shows hydremic or even dropsical tendencies, restriction of fluids must be rigidly enforced, the total amount permitted not exceeding 1 liter (quart). According to Perry there are cases in which an excessive amount of water (serum) in the tissues is practically the sole cause of the corpulency. **Ranke's normal diet** is recommended: Meat, 280 Gm. ($9\frac{1}{3}$ ounces); fat, 100 Gm. ($3\frac{1}{3}$ ounces); bread, 400 Gm. ($13\frac{1}{3}$ ounces), and the limitation of the amount of the fluid taken, allowing only from 300 to 400 c.c. (10 to 13 ounces) more of water to be ingested daily in food and drink than the daily amount of urine secreted.

These subjects require nutritious aliment, as tender meats, eggs, milk, green vegetables in normal amount, with moderate restriction of the fats and carbohydrates. A light acid wine—*e.g.*, dry Moselle, claret, or Rhine wine at dinner—is useful. The appetite shows impairment in many cases, and the patients insist often on a light lunch between meals and on retiring. According to Anders these should be allowed, and among the best dishes for the purpose are a cup of hot broth or bouillon with part of a French roll, a glass of milk with a graham wafer, a thin sandwich of scraped beef or chicken, or the like.

The writer has tried the **Karell cure** in obesity in a dozen cases, with good results. He allows a glass of milk four or five times a day for three days as the only nourishment, and the patient is kept in bed. The patient lost from 5 to 10 pounds, and even a little more when the diet was kept up a few days longer; but

the principal result was obtained in the first three days. It is evidently due to the lack of salt in the diet and the small amount of fluid, and far more attention should be paid to the salt and water metabolism in treatment of obesity than has been the case hitherto. The Karell diet should be restricted to patients in whom the obesity does not yield to the ordinary measures. Strauss (Med. Klinik, March 27, 1910).

Balneotherapy promotes oxidation, although less actively than muscular exercise. **Cold- or salt- water baths** of brief duration, followed by active **hand-rubbing** by the patient himself, are to be advised and encouraged. If, however, gouty manifestations or other contraindications exist, then **warm baths**, which aid elimination through the sweat-glands, should be employed.

Certain **spas**, especially **Carlsbad**, are effective in the plethoric, but not in the anemic type of obesity. In the latter form, milder aperient waters containing iron are often useful. Again, patients presenting serious cardiovascular diseases should not visit these spas. Among watering-places suitable for the moderate grades of plethoric obesity may be mentioned **Vichy** abroad, as well as **Saratoga** and the **Virginia Hot Springs** at home, the last named being especially well adapted to that large class of cases in which obesity is a consequence of gout. While the results obtained at these spas are often striking, they are rarely permanent unless the patient can be enjoined to continue certain details of treatment afterward.

Organotherapy.—The prevailing tendency to use **thyroid gland** in the treatment of every case of obesity is

seriously to be condemned. The cause or pathogenesis should always be taken into account when treatment is considered. If this is done, it will be found that thyroid gland is indicated in less than one-half of the cases met with. It is of marked benefit, however, in patients in whom deficient thyroid activity, *i.e.*, hypothyroidism, or larval myxedema, exists, which is the case much more frequently than is generally supposed. These patients, by the way, are often treated for rheumatism, there being pain or sensitiveness in the occipital region, migraine, aching between the shoulder-blades. A diagnostic feature of importance is that rest in bed tends to aggravate the pain rather than to relieve it. There is premature alopecia or grayness and, in women, "leakage" or stained leucorrhea in the absence of local lesions. While thyroid is of curative value here, large doses should not be employed; from 1 to 2 grains being a limit which cannot be exceeded without danger.

Case in which a man took for obesity nearly 1000 5-grain (0.3 Gm.) tablets of **thyroid extract** within five weeks. After the first three weeks he began rapidly to develop the symptoms of acute Graves's disease. When thyroid was stopped and the patient was put upon arsenic all the symptoms disappeared quickly, excepting the eye changes and the goiter, which were still notable for about six months. A. V. Notthaft (Centralbl. f. innere Med., April 16, 1898).

The lack of success from dietetic measures and palpation of the gland may suggest the presence of thyroid obesity, and this assumption is confirmed by the efficacy of extremely mild **thyroid** treatment, increasing from 0.1 to 0.3 Gm. (1½ to 5 grains) of gland substance (in tablet form) in

the course of three weeks and then reducing again, with a free interval of a week at the end of the month. The maximal dose is thus less than one-third of the average dosage of the last few years. With this technique the writer never has any by-effects; if polyuria should develop he would regard it as a sign that the individual dose was too high or the intervals too short. The most reliable index of cumulative action is the pulse. If the pulse runs up to 100 or 110 the thyroid extract should be suspended and rest imposed, not necessarily in bed. The pulse rate was increased in this way in 8 or 10 of his cases, but less frequently since he has perfected his technique. After two or three of these monthly thyroid courses he suspends the treatment for six or eight weeks, but as the aim is to supply a physiological deficiency, the thyroid extract has to be constantly supplied anew as the deficiency makes itself felt. Pariser (Med. Klinik, Aug. 15, 1909).

Another class of cases in which thyroid will prove advantageous is that in which a gouty diathesis is clear, especially where asthma, migraine, lithiasis, or eczema of the recurrent type is a feature of the history. Here **thyroid** and **regulation of diet** are very helpful. The one feature to be emphasized in this connection is that thyroid should only be used when strictly indicated and in small doses, and, moreover, only when the patient can be examined frequently, in order to discontinue temporarily its use, as soon as the heart shows by the increased rapidity—10 beats or more when seated—that the depressor nerve and the blood-pressure are being materially influenced.

It must be borne in mind in this connection that American preparations (U. S. P.) of desiccated thyroid gland contain 5 grains (0.3 Gm.) of

the fresh gland to the grain of desiccated gland, while an English preparation of the latter (Burroughs and Wellcome's), considerably used, contains but 1 grain of fresh gland. This would suggest that English physicians use enormous doses, whereas such is not the case.

Series of about 100 cases of obesity in which **thyroid extract** was used. No untoward symptoms were noticed in any of the cases; malaise, headache, palpitation, and nervous derangement being entirely absent. Albuminuria was not seen at any time. The thyroid gland used in all instances was B. W. & Co. tabloids. The initial dose was $2\frac{1}{2}$ grains (0.16 Gm.) with each meal, either mixed with the food or taken with a little water. After seven days the dose was increased to 5 grains (0.3 Gm. with each meal, and this dose was not increased in any case. The tabloids were crushed before being taken. In the successful cases summarized below no alteration in diet was ordered, the patient eating and drinking anything he or she desired. **Alcohol** was, however, **strictly prohibited** in any form.

Of 78 females treated 69 were between 25 and 45, their average weekly loss was $2\frac{1}{2}$ to 4 pounds, and the result was permanent cure; 9 were between 15 and 19, and there was no permanent result in any of them. Of 25 men 9 were between 30 and 47; they lost on an average 2 to $3\frac{1}{2}$ pounds, and the cure was permanent; 11 men between 30 and 47 lost 1 to $1\frac{1}{2}$ pounds on an average, but the result was not permanent; on 5, between 14 and 17, there was no effect at all. W. J. Hoyten (Brit. Med. Jour., July 28, 1906).

There is a distinct field for **thyroid** in certain cases of obesity, namely, the constitutional or thyrogenous type, where there is a small or inactive thyroid and poor catabolism. It may be given with care to the obese individual who is too fat to exercise,

in order to reduce his weight to a point where he may exercise. Formerly, owing to a lack of standardization in the preparations of the gland on the market there was a considerable amount of confusion as to its proper dose. Thus one maker's preparation was about the strength of the present official preparation, another's was two and a half times as strong, while still another's five-sixths as strong. Now there is the official *glandulæ thyroideæ siccae*, 1 grain (0.06 Gm.) of which represents 5 grains (0.3 Gm.) of the fresh gland. The writer advises beginning with small doses of a fresh preparation of the dried gland, $\frac{1}{2}$ to 1 grain (0.03 to 0.06 Gm.) three times daily, and gradually increasing it, being watchful for the first signs of intolerance. The **diet** should contain an increased quantity of proteids in order to save the tissue proteid, and a decreased quantity of carbohydrates to prevent glycosuria. While **exercise** may be dispensed with, it is valuable in that it trains the patient in this important particular. While taking the thyroid the patient should be under constant observation and should never be allowed to take the drug without advice. If during the administration of the extract the pulse rises above 100, and the patient complains of breathlessness and weakness, the thyroid should be stopped at once and arsenic in small doses given. Jump (Penn. Med. Jour., Oct., 1912).

In the *forms due to excessive adrenal activity*, thyroid would but add fuel to the fire, since already we are dealing with exaggerated metabolism. The obesity of castration is greatly benefited by thyroid, but in conjunction with **ovarian extract** or **corpora lutea**.

In the *types of pituitary origin*, Frölich's syndrome and Dercum's adiposis dolorosa, **pituitary gland** is valueless, though the prolonged use

of **thyroid** seems to be of benefit in some cases. Fortunately these forms are rarely met with.

Thyroid gland in therapeutic doses (0.2 Gm.—3 grains—of the dry powder, for example) has little effect on obesity. It increases the appetite and may thus fatten thin persons. **Pituitary treatment** sometimes gives results, but it is on **diet** and **physical exercise** that one must rely. Léopold-Lévi (Congress of French-speaking pediatricians, Paris, October 3 and 4, 1913).

A clear identification of the cause is no less necessary in the ordinary types of obesity. To administer thyroid or any ductless gland to an excessive eater, simply adds fuel to the fire. It increases his appetite; here the **dietetic treatment, exercise in the open air and massage** are sheet anchors. In cases of obesity that are traceable to emotions, fright, and shock, thyroid will soon bring on rapid heart action, dyspnea, and other morbid phenomena. Obesity following traumatism may be classed in the same category. This applies also to cases that follow infectious diseases, intoxications, hemorrhage, anemia, and chlorosis, the treatment here being that of the causative disease.

The so-called "lymphatic type" in which von Noorden, Magnus-Levy, and others have advised the use of thyroid, provides abundant opportunity for errors. Many cases which would suggest themselves as belonging to this type suffer from cardiac, renal, or vascular disorders; these thyroid tends to aggravate. Patients in whom albumin or casts are present in the urine or in whom there is any degree of cardiac disorder, will do badly under this remedy.

The surgical removal of slabs of fat,

i.e., **lipectomy**, has been advocated and may serve a good purpose in patients in whom great deformity and interference with one or more functions exist.

Two cases of abdominal **lipectomy**. In each instance there was a fat, flabby, pendulous belly. The slab of skin and fat removed in one case weighed a trifle over 7 pounds, and in the other measured 38 centimeters in length by 12 in width, weight not given. Maylord is given the credit of having removed 10 pounds.

The advantages of the operation are thus described by Kelly: The removal of a slab of fat and a decrease in weight; great addition to personal comfort generally; convenience and comfort in dressing; better pose in standing and better poise in walking; increased activity; cleanliness greatly facilitated; figure changed from unsightly and awkward to one much more natural; the sensitive patient occupying afterward a more normal and natural relation to society. Shallenberger (Johns Hopkins Hosp. Bull., Nov., 1911).

Lipectomy is indicated in young women whenever an excessive deposit of fat on the abdomen interferes with the menstrual function and leads to amenorrhea, especially when the latter condition is not amenable to other therapeutic agents. From a purely esthetic point of view it is a highly satisfactory operation. It is devoid of danger, and appears in some well-defined cases to increase tissue metabolism and restore ovarian activity. Casalis (Jour. Obstet. and Gynec. of Brit. Empire, Jan., 1912).

Electricity has been recommended, but its effects are fleeting; it may, however, be used as an adjuvant.

The writer uses **electric apparatus** which sets isolated parts of the muscular apparatus in rhythmic regulated action, similar to Bergonié's work in this line since 1909. The muscles are thus exercised without

fatiguing the patient. The method is proving useful in treatment of obesity, of contracture, of severe constipation and in atrophy of the muscles, in heart disease and asthma and after operations. The pulse and respiration are not affected. Nagelschmidt (Berl. klin. Woch., Jan. 27, 1913).

The writer has treated 20 obese patients with **electric exercising of the muscles**, but did not witness any reduction in weight greater than what was realized with ordinary dietetic restrictions without the "**bergonizing**." The main thing in treatment of obesity is and must be regulation of **diet**, and Bergonié himself only regards the **electric passive exercise** as one factor in the treatment. Roemheld (Münch. med. Woch., Dec. 30, 1913).

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OBSTRUCTION, INTESTINAL. See INTESTINES, DISEASES OF.

OCCULT BLOOD.—Occult blood is blood which cannot be detected on gross examination. It may be found: In the feces, in cases of duodenal ulcer and in malignant disease of the intestinal tract; in the urine, in cases of renal or ureteral calculus and in ulceration and malignant disease of the urinary organs; and in the gastric contents, in cases of gastric ulcer or malignant disease.

Although the fact that the blood has the power to cause guaiac to turn blue, on the addition of ozonized turpentine or hydrogen dioxide, was first made known by Schönbein in 1856, it was not until later, through the investigations of Van Deen (1861), Liman (1863), Day (1867), Taylor (1868), and others, that our knowledge of the guaiac test was sufficient to allow of its clinical application. Van Deen showed that the smallest quantity of blood, no matter how old or how mixed with other substances, was colored blue by tincture of guaiac and an ozone carrier, such as oil of turpentine.

Nearly all the chemical tests for blood depend upon the power of the blood to cause the oxidation of various chromogenic

substances, by means of oxidizing agents of the hydrogen-dioxide type, the blood acting as an oxygen carrier, not, as was formerly believed, by reason of a contained oxidase or peroxidase, but by reason of its iron content (boiling will destroy the oxidases, but as long as iron is present the reaction can be obtained). The blood appears to seize the oxygen of the oxidizing agent and to carry it to and deliver it up to the chromogenic substance, thus producing the characteristic color of a positive reaction.

A number of chromogenic substances have been used for this purpose, guaiac, aloin, the leuco-base of malachite green, benzidin, phenolphthalin (not phenolphthalein), etc., and various oxidizing agents—ozonized turpentine, hydrogen dioxide and perhydrol, ozonized ether, etc., giving rise to many tests, the best known being Van Deen's guaiac, Rossel's aloin, Schuman's benzidin, and Kastle's phenolphthalin tests, with many modifications of each.

Another reagent, brought forward by Ruttan and Hardisty, in 1912, is tolidin or orthotolidin, a crystalline basic substance of the aromatic series, very slightly soluble in water, more soluble in glacial acetic acid, and freely soluble in alcohol and in ether, and closely allied to toluidin and benzidin. This reagent is more satisfactory than even benzidin, because of its great delicacy, its more lasting color, and the fact that in solution it remains unimpaired for three or four weeks.

PRELIMINARY PRECAUTIONS.—

Many substances, such as pus, mucus, and various animal and vegetable ferments which can themselves give a positive reaction, must be excluded by boiling the suspected secretion or excretion. When the feces are to be examined, the patient must refrain from the use of meat, and is kept on a lactovegetarian diet, or, better, a strict milk diet for from three to ten days before the test. The test itself must be immediately preceded by a cleansing enema, and the suspected stools, secured later, must be boiled and cooled for the test. The swallowing of blood-stained sputa and the presence of hemorrhoids may give rise to error in the findings and must be reckoned with. The stools may

be "marked off" if desired by adding carmine to the milk. Again, the secretions and excretions may contain substances that have a reducing action; that is to say, they possess the power of seizing and appropriating the oxygen of the oxidizing substance, so that none is available to oxidize the reagent, and so prevent a positive reaction.

TECHNIQUE.—The guaiac, benzidin, hematin and other tests for occult blood in the urine have already been described (see HEMATURIA, volume v). Their application in the examination of the feces for occult blood will suggest itself, after the patient and the feces have been properly prepared.

The stool to be examined is dried and a 2 per cent. emulsion of it is made and boiled. One c.c. of this emulsion is used for the test.

The reagents may be made up as follows: Guaiac in methylated spirits, 1:25; benzidin and tolidin in solutions of similar strength, but in glacial acetic acid; the phenolphthalin reagent is difficult of preparation outside of a well-equipped laboratory, is very unstable (not good longer than forty-eight hours), and may be omitted here.

The oxidizing agent used is hydrogen dioxide, or, better, Merck's C. P. Perhydrol diluted with redistilled water down to about a 3 per cent. solution—the strength of the ordinary commercial product.

For the test 1 c.c. each of the reagent and of the emulsified stool are first mixed in a test-tube, and then, in all cases, 1 c.c. of hydrogen dioxide is added (except when the phenolphthalin solution, which already contains it, is used), and the whole is carefully shaken. It should be here remarked that when the amount of occult blood is small the reagent solution should be diluted, as a strong solution would mask the weak reaction.

The reaction color with the guaiac reagent is green, then brownish red, then violet, and finally blue; with the benzidin reagent, green (appearing promptly) turning to a dirty purple after from five to fifteen minutes; with aloin, red; with phenolphthalin, red to pink; with tolidin reagent the reaction color is green to a

blue black, depending on dilution, which does not develop rapidly but appears more gradually and increases in intensity, the colors lasting sometimes several hours.

A negative reaction denotes the absence of blood; when the reaction is positive it should be confirmed by the microscope and spectroscope.

Certain substances other than blood react with guaiac and other chromogenic substances employed in blood examination, alone or with hydrogen dioxide; among them are: the halogens, ozone, ammonia, finely divided metals, compounds of certain heavy metals (cobalt, copper, gold, iron, lead, manganese, and silver salts, and mercuric chloride), substances of animal origin (animal ferments, ash of blood, gelatin, milk, organic secretions—bile and mucus, feces after diet of raw or cooked meat or foods containing blood, nasal mucus, pus, saliva, leucocyte-bearing secretions, red flesh, albumin, peptone, sweat), many substances of vegetable origin (especially asparagus, beans, peas, onions, potatoes, tomatoes, fresh walnuts, fruits and berry juices, watermelon pulp, etc.), many organic substances (alcohol, amyl nitrite, aniline, ether, many aldehydes, nitrous ether, etc.), certain medicinal preparations, certain phosphorizing substances, flannel, ink stains, leather, papers (especially filter-paper and glazed papers containing alum), and soap (J. H. Kastle). W.

OCCUPATION DISORDERS.

—Legislation is increasingly being enacted to protect workers in aniline dyes, lead, phosphorus, arsenic, mercury and their compounds, wood or methyl alcohol, anthrax and compressed air. All these disorders will be found described in this work under their respective headings.

OESOPHAGUS, DISEASES OF.

See ESOPHAGUS, DISEASES OF.

OLFACTORY NERVES, DISEASES OF. See NOSE AND NASOPHARYNX, DISEASES OF.

OLIVE OIL.—Olive oil (oleum olivæ, U. S. P.) is a fixed oil expressed from the ripe fruit of *Olea Europæa*, (nat. ord., Oleaceæ), or olive tree, indigenous to the countries bordering upon the Mediter-

anean, but cultivated in all the semi-tropical countries of the world. It is yellow or greenish yellow in color, has a sweetish taste, and is almost devoid of odor. The greenish-yellow-colored oil is considered the most delicate, and is rarely an article of export. The best, or virgin, oil is obtained from the crushed, ripe fruit, by expression without heat; a second grade is obtained by the addition of hot water to the same crushed fruit and a second expression. From the residue, after boiling, an inferior grade is made by means of very strong pressure. The best is nearly tasteless and without color, the second has more taste and color, and the third is dark and more or less rancid, with strong odor. Olive oil is one of the ingredients of lead plaster (Br. P.) and of diachylon ointment (U. S. P.), and is also used in the preparation of liniments and cerates. Olive oil is soluble in ether, chloroform, benzene, benzin, and carbon disulphide, and in about 5 parts of acetic ether.

THERAPEUTICS.—Olive oil is a lubricant, laxative, and nutrient. Internally and by enema it is given for **constipation**, in doses of from $\frac{1}{2}$ to 6 ounces (15 to 200 Gm.). The oil is a soothing laxative in cases of **hemorrhoids** and **fissure of the anus**. It is a useful remedy in all forms of **irritant poisoning**, except that by phosphorus. In increasing doses from $\frac{1}{2}$ to 3 ounces it has caused the disappearance of **obstructive jaundice**. It has been used in the treatment of **gall-stone**, **hepatic**, and **lead colic** in doses of 3 to 6 ounces. Bram has relieved most stubborn cases of lead colic and the accompanying persistent constipation by the use of a tumblerful of olive oil once daily. Free catharsis occurred on the second or third day and the nervous symptoms subsided.

In obstinate and painful cases of **dry pleurisy** the injection of $\frac{1}{2}$ dram (2 Gm.) of sterilized olive oil into the pleural sac, over the site of the friction sounds, often gives prompt relief.

In young children and infants good results have been obtained by the inunction of 1 dram (4 Gm.) of olive oil once or twice daily. Infants with **constipation** and **malnutrition** improve under 1 dram (4

Gm.) of the oil administered once or twice daily.

In **progressive anemia** (pernicious or symptomatic) equal parts of olive oil and glycerin, given in gradually increasing doses two hours after each meal, produces happy results.

Olive oil is a useful application to the skin in **scarlatina** and other **eruptive diseases**, as it seems to assist desquamation and prevents the dissemination of the scales.

Olive oil has been used by inunction, or as an article of diet in **wasting diseases**. For this purpose it is much inferior to codliver oil. It has recently been used hypodermically as a nutrient to supplement or replace codliver oil in case of needed rectal alimentation. When given by mouth it is best administered cold in gradually increasing doses, about two hours after meals, either alone or flavored with glycerin, orange-juice, coffee, or sarsaparilla syrup (Bram).

In **typhoid fever**, olive oil administered as a food in doses of 1 to 3 ounces (30 to 90 Gm.) three times daily, is a valuable aid in overcoming the tendency to emaciation, and is also available as a safe laxative in this disease, being sometimes given in the form of a lukewarm high injection.

Rectal enemata of olive oil are highly beneficial in the treatment of **mucomembranous colitis**, the **constipation of neurasthenia**, and in **intestinal atony**.

In **chronic dysentery** excellent results have followed the continued use of olive oil given in large quantities. Starting with a dose of 1 ounce (30 Gm.) three times a day, this is gradually increased to 4 ounces (125 Gm.). In **gastric ulcer**, Cohnheim believes that olive oil relieves the pain, lubricates the surfaces of the ulcers or fissures, reduces hyperacidity, and acts as an easily digested food.

Ferguson calls attention to the use of olive oil as a speedy restorative of the patient's power to resist **infection**. He advises, in connection with anesthesia, a high rectal injection of 6 ounces (200 Gm.) of olive oil in all **septic cases** and in all others in which the patient's power to resist infection may be invoked. As he remarks, a very slight infection which would not manifest itself under ordinary

circumstances may develop into a serious condition after anesthesia, because of the impaired resistance. The oil should be pure and limpid, and the injection made very slowly.

Graham, arguing from the fact that substances such as fats, which are soluble in ether, are capable of restoring to the blood certain properties, such as phagocytosis, more or less impaired by **anesthesia**, concluded that other effects, as **postanesthetic nausea and vomiting**, might be similarly influenced. This was confirmed by experiment. As soon as the patient began to recover consciousness from the anesthetic, olive oil was given in doses of 1 ounce (30 Gm.), and in most cases the usual nausea did not appear. In other cases in which nausea was already present, the administration of the oil caused a cessation of the nausea. In only 1 of 30 patients treated was nausea observed after taking the oil.

Externally olive oil is a soothing application to **burns, wounds, and raw surfaces**. Dropped into the ear, it is a useful means for expelling **insects** that may have found their way thence. W.

ONYCHIA. See NAILS, DISEASES OF.

OÖPHORITIS. See OVARIES AND FALLOPIAN TUBES, DISEASES OF.

OPACITIES OF THE CORNEA. See CORNEA, DISORDERS OF.

OPHTHALMIA. See CONJUNCTIVA, DISEASES OF.

OPIUM AND DERIVATIVES.—Opium, as officially recognized, is the concrete, milky exudation obtained by incising the unripe capsules of *Papaver somniferum* (family, Papaveraceæ), or white poppy-plant, an annual herb indigenous to Asia, and now cultivated in Asia Minor, China, India, and Persia. It occurs in moist, semisolid chestnut-colored masses or lumps, weighing about $\frac{1}{2}$ to 2 pounds, with an earthy, narcotic odor and a bitter taste. The

crude drug, in its normal, moist condition, is required officially to contain not less than 9 per cent. of pure, crystallized morphine.

The principal active substances of opium may be extracted by water, alcohol, and by dilute acid, but not by ether. The chemical composition of the drug is very complex. About twenty alkaloids have been found in it, including *morphine* (5 to 22 per cent.), *codeine* (0.2 to 0.7 per cent.), *narcotine*, (1 to 10 per cent., average 6 per cent.), *narceine* (0.1 to 0.2 per cent.), *papaverine* (1 per cent.), and *thebaine* (0.15 to 1 per cent.), together with small amounts of pseudomorphine, codamine, laudanine, laudanosine, oxynarcotine, papaveramine, meconine, meconidine, lanthopine, cryptopine, hydrocotarnine, protopine, rheadine, gnoscopine, and tritopine. In addition there are present meconic acid in combination with the alkaloids; lactic acid, wax, meconates of calcium and magnesium, meconoisin, etc.

Among the alkaloids of the morphine-codeine group not contained in opium, but prepared artificially in the laboratory, are: (1) *Heroine*, or diacetyl morphine. (2) *Dionin*, or ethyl-morphine hydrochloride. (3) *Peronin*, or benzyl-morphine hydrochloride. (4) *Apomorphine*, derived from morphine by dehydration. (5) *Apocodeine*, derived from codeine by dehydration. Of these, apomorphine has already been considered (see APOMORPHINE). The remaining four will be discussed serially at the close of the sections Preparations and Dose, and Physiological Action, in this article.

PREPARATIONS AND DOSE.

A. Solid Preparations:—*Opium*, U. S. P. (opium; gum opium), containing not less than 9.5 per cent. of morphine.

Dose, $\frac{1}{2}$ to 3 grains (0.03 to 0.2 Gm.); average, $1\frac{1}{2}$ grains (0.1 Gm.), containing about $\frac{1}{6}$ grain (0.01 Gm.) of morphine.

Opium deodoratum, U. S. P. (deodorized opium; denarcotized opium), the residue left after treatment of opium with purified petroleum benzine, which removes odorous principles from the crude drug. It is required to contain 10 to 10.5 per cent. of morphine. Dose, $\frac{1}{2}$ to 2 grains (0.03 to 1.3 Gm.); average, 1 grain (0.06 Gm.), containing about $\frac{1}{8}$ grain (0.008 Gm.) of morphine.

Opium granulatum, U. S. P. (granulated opium), consisting of opium dried at a temperature not exceeding 85° C. and reduced to a coarse powder. It is required to contain 10 to 10.5 per cent. of morphine. Dose, $\frac{1}{2}$ to 2 grains (0.03 to 1.3 Gm.); average, 1 grain (0.06 Gm.).

Opium pulvis, U. S. P. (powdered opium), consisting of opium dried at a temperature not exceeding 85° C. and reduced to a very fine powder. It contains 10 to 10.5 per cent. of morphine. Dose, $\frac{1}{2}$ to 2 grains (0.03 to 1.3 Gm.); average, 1 grain (0.06 Gm.).

Extractum opii, U. S. P. (extract of opium), made by extraction of powdered opium with water and addition of enough sugar of milk to bring the morphine content of the finished drug extract to 20 per cent. Dose, $\frac{1}{4}$ to 1 grain (0.015 to 0.06 Gm.); average, $\frac{1}{2}$ grain (0.03 Gm.), containing $\frac{1}{10}$ grain (0.006 Gm.) of morphine.

Pilula opii, U. S. P. (pills of opium), each representing 1 grain (0.065 Gm.) of powdered opium. Dose, 1 pill, containing about $\frac{1}{8}$ grain (0.008 Gm.) of morphine.

Pulvis ipecacuanhæ et opii, U. S. P. (powder of ipecac and opium; Dover's

powder), containing ipecac and powdered opium, of each, 1 part; sugar of milk, 8 parts. Dose, 5 to 15 grains (0.3 to 1 Gm.); average, $7\frac{1}{2}$ grains (0.5 Gm.), containing nearly $\frac{1}{8}$ grain (0.008 Gm.) of morphine.

Trochisci glycyrrhizæ et opii, U. S. P. VIII (troches of licorice and opium; Wistar's cough lozenges), containing $\frac{1}{12}$ grain (0.005 Gm.) of powdered opium— $\frac{1}{100}$ grain (0.0006 Gm.) of morphine,—together with extract of licorice, acacia, sugar, and oil of anise.

Emplastrum opii, U. S. P. VIII (opium plaster), made by rubbing 6 parts of extract of opium with 8 parts of water, adding 90 parts of adhesive plaster—previously melted—and continuing to heat, with constant stirring, until the total product equals 100 parts.

B. Fluid Preparations.—*Tinctura opii*, U. S. P. (tincture of opium; laudanum), a 10 per cent. preparation of granulated opium, required to yield from 0.95 to 1.05 per cent. of the anhydrous alkaloid morphine. Dose, 1 to 20 minims (0.06 to 1.25 c.c.); average, 8 minims (0.5 c.c.).

Tinctura opii deodorati, U. S. P. (tincture of deodorized opium; deodorized laudanum; McMunn's elixir), a preparation similar to the preceding, deodorized by extraction of the opium used with petroleum benzin. Dose, 1 to 20 minims (0.06 to 1.25 c.c.); average, 8 minims (0.5 c.c.).

Tinctura opii camphorata, U. S. P. (camphorated tincture of opium; paregoric), representing 0.4 per cent. of powdered opium, together with 0.4 per cent. each of benzoic acid, camphor, and oil of anise, 4 per cent. of glycerin, and 95 per cent. of diluted alcohol. Each fluidram (4 c.c.) of the tincture contains about $\frac{1}{30}$ grain (0.002 Gm.) of morphine. Dose, 1 to 4 fluidrams

(4 to 16 c.c.); average, 2 fluidrams (8 c.c.).

Tinctura ipecacuanhæ et opii, U. S. P. VIII (tincture of ipecac and opium), representing an equal volume of tincture of deodorized opium with the addition of 10 per cent. by volume of fluidextract of ipecac. It therefore contains 10 per cent. of opium and 1 per cent. of ipecac. Dose, 5 to 15 minims (0.3 to 1 c.c.); average, 8 minims (0.5 c.c.).

Acetum opii, U. S. P. VIII (vinegar of opium; black drop), representing 10 per cent. of powdered opium, extracted with diluted acetic acid. It also contains 20 per cent. of sugar and is flavored with nutmeg. Dose 5 to 15 minims (0.3 to 1 c.c.); average, 8 minims (0.5 c.c.).

Vinum opii, U. S. P. VIII (wine of opium; Sydenham's laudanum), representing 10 per cent. of granulated opium, extracted with white wine. The menstruum of the finished preparation is a mixture in equal parts of white wine and alcohol, and is flavored with cinnamon and cloves. Dose, 1 to 20 minims (0.06 to 1.25 c.c.); average, 8 minims (0.5 c.c.).

Opium, in small amount, is present in the compound licorice mixture:—

Mistura glycyrrhizæ composita, U. S. P. (compound mixture of glycyrrhiza; brown mixture), each 2 fluidrams (8 c.c.) of which contain approximately 15 minims (1 c.c.) of camphorated opium tincture, $\frac{1}{32}$ grain (0.002 Gm.) of tartar emetic, 4 minims (0.25 c.c.) of spirit of nitrous ether, and 4 grains (0.25 Gm.) of pure extract of glycyrrhiza, together with acacia and syrup. Dose, 1 to 4 fluidrams (4 to 16 c.c.); average, $2\frac{1}{2}$ fluidrams (10 c.c.).

C. Alkaloidal Preparations.—*Morphina*, U. S. P. (morphine, morphia)

[$C_{17}H_{19}NO_3 + H_2O$], occurring in colorless rhombic prisms or fine needles, odorless, bitter, and permanent in the air. It is soluble only in 3330 parts of water, and also practically insoluble in ether and chloroform, but dissolves in 168 parts of alcohol and in 100 parts of lime-water. Dose, $\frac{1}{16}$ to $\frac{1}{3}$ grain (0.004 to 0.02 Gm.); average, $\frac{1}{5}$ grain (0.012 Gm.).

Morphinæ acetat, U. S. P. VIII (morphine acetate) [$C_{17}H_{19}NO_3 \cdot C_2H_4O_2 + 3H_2O$], occurring as a white or yellowish, crystalline or amorphous powder, with a faint acetous odor and a bitter taste. It loses acetic acid gradually upon exposure to air, thereby becoming less soluble in water. It dissolves in 2.25 parts of water, 21.6 parts of alcohol, and 480 parts of chloroform, and is insoluble in ether. Dose, $\frac{1}{12}$ to $\frac{1}{2}$ grain (0.005 to 0.03 Gm.); average, $\frac{1}{4}$ grain (0.015 Gm.).

Morphinæ hydrochloridum, U. S. P. (morphine hydrochloride) [$C_{17}H_{19}NO_3HCl + 3H_2O$], occurring in white, glistening needles or cubes, or as a crystalline powder, odorless, bitter, and permanent in the air. It is soluble in 17.2 parts of water and in 42 parts of alcohol, but is insoluble in ether or chloroform. Dose, $\frac{1}{12}$ to $\frac{1}{2}$ grain (0.005 to 0.03 Gm.); average, $\frac{1}{4}$ grain (0.015 Gm.).

Morphinæ sulphas, U. S. P. (morphine sulphate) [$(C_{17}H_{19}NO_3)_2H_2SO_4 + 5H_2O$], occurring in white, acicular crystals or cubical masses, odorless, bitter, and permanent in the air. It is soluble in 15.3 parts of water and in 465 parts of alcohol, but is insoluble in ether or chloroform. Dose, $\frac{1}{12}$ to $\frac{1}{2}$ grain (0.005 to 0.03 Gm.); average, $\frac{1}{4}$ grain (0.015 Gm.).

Codeina, U. S. P. (codeine; codeia) [$C_{18}H_{21}NO_3 + H_2O$], occurring in

white prisms or octahedrons, or as a crystalline powder, odorless, with a faint, bitter taste, and slightly efflorescent in warm air. It is soluble in 120 parts of water, 1.6 parts of alcohol, 12.5 parts of ether, and 0.66 part of chloroform. Dose, $\frac{1}{8}$ to 2 grains (0.015 to 0.12 Gm.); average dose, $\frac{1}{2}$ grain (0.03 Gm.).

Codeinæ phosphas, U. S. P. (codeine phosphate) [$C_{18}H_{21}NO_3 \cdot H_3PO_4 + 2H_2O$], occurring in fine, white needles or a crystalline powder, odorless, and with a bitter taste. It is soluble in 2.25 parts of water and in 261 parts of alcohol, but is practically insoluble in ether or chloroform. Dose, $\frac{1}{8}$ to 2 grains (0.015 to 0.12 Gm.); average, $\frac{1}{2}$ grain (0.03 Gm.).

Codeinæ sulphas, U. S. P. (codeine sulphate) [$(C_{18}H_{21}NO_3)_2 \cdot H_2SO_4 + 5H_2O$], occurring in long needles, rhombic prisms, or as a crystalline powder, odorless, and with a bitter taste. It effloresces in the air. It is soluble in 23 parts of water, but only 1035 parts of alcohol, and is insoluble in ether and chloroform. Dose, $\frac{1}{8}$ to 2 grains (0.015 to 0.12 Gm.); average, $\frac{1}{2}$ grain (0.03 Gm.).

Pulvis morphinæ compositus, U. S. P. VIII (compound powder of morphine; Tully's powder), containing 1.5 per cent. of morphine sulphate, 32 per cent. of camphor, 33 per cent. of licorice, and 33.5 per cent. of precipitated chalk. Dose, 5 to 15 grains (0.3 to 1 Gm.); average, $7\frac{1}{2}$ grains (0.5 Gm.), containing $\frac{1}{8}$ grain (0.0075 Gm.) of morphine sulphate.

D. Semiofficial Preparations.—*Pilulæ opii et camphoræ*, N. F. (pills of opium and camphor), each containing 1 grain (0.06 Gm.) of powdered opium and 2 grains (0.12 Gm.) of camphor. Dose, 1 pill.

Pilulæ opii et plumbi, N. F. (pills of opium and lead), containing 1 grain (0.06 Gm.) each of powdered opium and lead acetate. Dose, 1 pill.

Pulvis cretæ et opii aromaticus N. F. (aromatic powder of chalk and opium), containing 2.5 per cent. of powdered opium, together with cinnamon, crocus, nutmeg, cloves, cardamom, prepared chalk and sugar. Dose, 30 grains (2 Gm.), containing $\frac{3}{4}$ grain (0.05 Gm.) of powdered opium.

Pulvis kino et opii compositus, N. F. (compound kino powder), powdered opium, 5 parts, with kino, 75 parts, and cinnamon, 20 parts. Dose, 15 grains (1 Gm.), containing $\frac{3}{4}$ grain (0.05 Gm.) of powdered opium.

Mistura pectoralis, N. F. (pectoral mixture; Stokes's mixture), each fluidram representing 10 minims (0.6 c.c.) of camphorated opium tincture, 1 grain (0.06 Gm.) of ammonium carbonate, and 2 grains (0.12 Gm.) each of senega and squill, with syrup of Tolu. Dose, 1 to 2 fluidrams (4 to 8 c.c.).

Mistura camphoræ acida, N. F. (acid mixture of camphor; Hope's mixture), each 2 fluidrams (8 c.c.) containing about $1\frac{1}{2}$ minims (0.1 c.c.) of tincture of opium and 21 minims (1.3 c.c.) of nitric acid, the remainder being camphor water. Dose, 2 to 4 fluidrams (8 to 16 c.c.).

Mistura carminativa, N. F. (carminative mixture; Dalby's carminative), containing 1 grain (0.06 Gm.) of opium in each fluidounce (30 c.c.), together with magnesium carbonate, potassium carbonate, and carminative oils. Dose, 1 fluidounce (30 c.c.); in infants, 8 minims (0.5 c.c.).

Mistura opii et sassafras, N. F. (mixture of opium and sassafras; Godfrey's cordial), each fluidram (4 c.c.) containing about 2 minims (0.12 c.c.) of tinc-

ture of opium. Dose, 2 fluidrams (8 c.c.); in infants, as anodyne and carminative, 5 minims (0.3 c.c.).

Misturæ contra diarrhæam, N. F. III (cholera mixtures), including the "Sun" cholera mixture, Squibb's diarrhea mixture, and Loomis's, Thielmann's, and Velpeau's mixtures. (For composition, see National Formulary.) Dose of each, 30 minims (2 c.c.).

Mistura chloroformi et morphinæ composita, N. F. (chloroform anodyne), each fluidram (4 c.c.) of which represents about $\frac{1}{7}$ grain (0.009 Gm.) of morphine sulphate, $7\frac{1}{2}$ minims (0.5 c.c.) of chloroform, 11 minims (0.75 c.c.) of tincture of cannabis indica, and 2 minims (0.12 c.c.) of tincture of capicum. Dose, 30 minims (2 c.c.).

Liquor morphinæ citratis, N. F. III (solution of morphine citrate), every 5 minims (0.3 c.c.) containing $\frac{1}{6}$ grain (0.01 Gm.) of morphine citrate. Dose, 5 minims (0.3 c.c.).

Liquor morphinæ hypodermicus, N. F. III (Magendie's solution); every 5 minims (0.03 c.c.) containing $\frac{1}{6}$ grain (0.01 Gm.) of morphine sulphate in sterilized water, with a small amount of salicylic acid added as a preservative. Dose, 5 minims (0.3 c.c.).

Syrupus morphinæ et acaciæ, N. F. (Jackson's pectoral syrup), each fluidram (4 c.c.) containing $\frac{1}{32}$ grain (0.002 Gm.) of morphine sulphate in syrup of acacia, flavored with sassafras. Dose, 1 fluidram (4 c.c.).

Syrupus morphinæ sulphatis, N. F. III (syrup of morphine sulphate), each fluidram (4 c.c.) containing $\frac{1}{8}$ grain (0.008 Gm.) of morphine sulphate. Dose, 30 minims (2 c.c.).

Syrupus morphinæ compositus, N. F. III (compound syrup of morphine), each fluidram (4 c.c.) representing $\frac{1}{32}$ grain (0.002 Gm.) of morphine sul-

phate, $\frac{1}{8}$ grain (0.008 Gm.) of ipecac, 1 grain (0.06 Gm.) of rhubarb, and 6 grains (0.4 Gm.) of senega, flavored with sassafras. Dose, 1 fluidram (4 c.c.).

Syrupus pini strobi compositus cum morphina, N. F. (compound white-pine syrup), 30 minims (2 c.c.) representing $\frac{1}{16}$ grain (0.004 Gm.) of morphine sulphate, together with white-pine bark and wild-cherry bark, and small quantities of spikenard, balm of gilead buds, sanguinaria, sassafras, and chloroform. Dose 30 minims (2 c.c.).

Syrupus codeinæ, N. F. (syrup of codeine), each fluidram (4 c.c.) containing $\frac{1}{8}$ grain (0.008 Gm.) of codeine sulphate. Dose, 1 fluidram (4 c.c.).

Elixir picis compositum, N. F. III (compound tar elixir), each fluidram (4 c.c.) representing $\frac{1}{50}$ grain (0.0013 Gm.) of morphine sulphate, with syrup of wild cherry, syrup of Tolu, and wine of tar. Dose, 1 to 2 drams (4 to 8 c.c.).

Elixir terpini hydratis et codeinæ N. F. (elixir of terpin hydrate and codeine), each fluidram (4 c.c.) representing 1 grain (0.06 Gm.) of terpin hydrate and $\frac{1}{8}$ grain (0.008 Gm.) of codeine. Dose, 1 fluidram (4 c.c.).

Elixir terpini hydratis, et diacetylmorphinæ, N. F. (elixir of terpin hydrate with heroine), each fluidram (4 c.c.) representing 1 grain (0.06 Gm.) of terpin hydrate and $\frac{1}{65}$ grain (0.001 Gm.) of heroine. Dose, 1 fluidram (4 c.c.).

Lotio plumbi et opii, N. F. (lead and opium wash), containing 1.75 per cent. of lead acetate and 3.5 per cent. of tincture of opium. Shaken before use.

Linimentum opii compositum, N. F. (compound opium liniment), consisting of opium tincture, 10 parts; ammonia-water, 35 parts; alcohol, 25 parts; oil of peppermint, 2.5 parts; camphor, 1.75 parts, egg albumen, 5, and oil of turpentine, to make 100 parts.

E. Related Alkaloids.—*Diacetylmorphinæ hydrochloridum*, U. S. P. (heroine hydrochloride) $[C_{17}H_{17}(C_2H_3O)_2NO_3HCl]$, seen as a white, crystalline odorless powder, with a bitter taste, soluble in 2 parts of water and in alcohol. Dose, $\frac{1}{24}$ to $\frac{1}{6}$ grain (0.0025 to 0.01 Gm.); average, $\frac{1}{12}$ grain (0.005 Gm.).

Aethylmorphinæ hydrochloridum, U. S. P. (dionin) $[C_{17}H_{18}(C_2H_5)NO_3 \cdot HCl + 2H_2O]$, occurring as white, crystalline, odorless powder, with a slight bitter taste, soluble in about 7 parts of water and in 2 parts of alcohol. Dose, $\frac{1}{4}$ to 1 grain (0.015 to 0.06 Gm.); average, $\frac{1}{2}$ grain (0.03 Gm.).

F. Unofficial Related Preparations.—Peronin (benzyl-morphine hydrochloride) $[C_{17}H_{18}(C_6H_5)CH_2NO_3 \cdot HCl]$, occurring as a white, odorless powder, soluble in water and diluted alcohol. Dose, $\frac{1}{6}$ to $\frac{2}{3}$ grain (0.01 to 0.04 Gm.).

Papaverine hydrochloride $[C_{20}H_{21}NO_4 \cdot HCl]$, occurring in colorless crystals or as a white crystalline powder, soluble in water. Dose, for children, $\frac{1}{12}$ to $\frac{1}{3}$ grain (0.005 to 0.02 Gm.).

Narcotine hydrochloride $[C_{22}H_{23}NO_7 \cdot HCl]$, occurring as a white powder, soluble in water. Dose, $1\frac{1}{2}$ to 3 grains (0.1 to 0.2 Gm.).

Apocodeine hydrochloride $[C_{18}H_{19}NO_2 \cdot HCl]$, occurring as a yellowish-gray to greenish-gray hygroscopic powder, soluble in water. Dose, $\frac{1}{3}$ to 1 grain (0.02 to 0.06 Gm.).

Pantopon (omnupon), a mixture of the total alkaloids of opium, soluble in water and suitable for hypodermic injection. Dose, $\frac{1}{4}$ to $\frac{3}{4}$ grain (0.015 to 0.05 Gm.).

Report of results obtained with narcophine, which was given in 15, 20, or 30 drops of a 3 per cent. solution internally; subcutaneously, 1 c.c. (16

minims) was used. The results were very satisfactory. Sleep was quiet, long, and refreshing. By-effects were not observed, but the effect upon digestion was very evident and consisted in diminution of peristalsis. No action upon the pupils or upon breathing was observed. Zehbe (Münch. med. Woch., July 9, 1912).

Codeonal is a hypnotic containing in each tablet 0.02 Gm. ($\frac{1}{3}$ grain) of codeine diethylbarbiturate and 0.15 Gm. ($2\frac{1}{2}$ grains) of sodium diethylbarbiturate. The doses used consisted of 2, 3, or 4 tablets after the evening meal. In psychosis and neuropsychosis combined with general unrest and in the severely excited the remedy did not suffice as a sedative. On the other hand, it was very useful in patients with general **nervous excitement** or **exhaustion** of a milder nature, as well as in **organic nerve affections associated with pain**. In these it is a valuable substitute for veronal. It is also indicated in **insomnia where there is distressing dyspnea or cough**. Lena (Med. Klinik, June 8, 1913).

Narcophine, the meconate of morphine-narcotine, containing about one-third its weight of morphine, has certain advantages not possessed by morphine. It does not influence respiration, rarely causes vomiting, and has a more lasting action than morphine. The dose, 0.03 Gm. ($\frac{1}{2}$ grain), the amount contained in the ampules on the market, is not sufficient for all conditions, as, for instance, in the severe pain of **renal** or **gall-stone colic**. In such cases the writer uses $1\frac{1}{2}$ to 2 ampules; that is 0.045 to 0.06 Gm. ($\frac{3}{4}$ to 1 grain) of narcophine. Narcophine produces its effects less quickly than morphine, bringing about a gradual quieting of the patient, which, however, lasts much longer than after a hypodermic of pure morphine. After the immediate effects of $1\frac{1}{2}$ to 2 ampules of narcophine have worn off, there is less of a feeling of dullness and lassitude. S. Hirsch (Deut. med. Woch., Nu. 14, 1914).

The most important advantages of pantopon are, solubility in water, and the fact that the presence of the by-alkaloids of opium renders the preparation less active on the respiratory center. While the drug is an efficient agent in the symptomatic treatment of diarrhea, when fulfilling its office as an analgesic, hypnotic, etc., its constipating action is so slightly marked as to be almost negligible. To get the full action on peristalsis, the preparation must be given on an empty stomach. The alkaloids thus come into intimate contact locally in relatively high concentration. When giving it by the mouth to allay a troublesome **cough**, constipation can be obviated by suitable distribution of small doses and avoiding giving them on an empty stomach. Where injections of pantopon are made for hypnotic or analgesic effects, the constipating action is not in evidence. Notwithstanding this, **diarrhea** can be controlled with ease by subcutaneous injection of it. This can be explained by the well-known pharmacological rule that an irritated function can be more easily checked than one not pathologically excited. H. Sahli (Brit. Med. Jour., Aug. 22, 1914).

MODES OF ADMINISTRATION.—Opium may be satisfactorily administered either in fluid or solid preparations, generally by mouth. Where relief of only moderately severe pain is required, small doses of tincture of opium may be used with success. In severe pain, on the other hand, hypodermic injection of morphine is instead advisable, a much more prompt effect being produced, with relatively less influence in arresting intestinal activity and impairing appetite. Where diaphoresis is the end in view, Dover's powder, or some other combination of opium with ipecacuanha, is generally given preference. For astringent effects, opium should be administered in small doses in the form of the cam-

phorated tincture (paregoric), or in conjunction with chalk or one of the true astringent drugs. If a prolonged sedative as well as astringent effect on the bowel or stomach is to be procured, opium pills are particularly suited, not being dissolved and absorbed as rapidly as the fluid preparations of the drug. Suppositories of opium and belladonna may be advantageously used in dysentery and irritative diseases of the rectum. Where, on the other hand, a hypnotic effect is demanded, opium may be advantageously given with other soporific drugs, such as chloral hydrate, veronal, or trional, its unpleasant by-effects being therefore reduced owing to the relative smallness of the dose employed. In general, opium or morphine, used by mouth, should be taken some time after meals.

INCOMPATIBILITIES.—Precipitation occurs in fluid opium preparations upon the addition of salts of lead, mercury, iron, copper, and zinc, an insoluble meconate being formed. Alkalies, alkaline carbonates, and lime-water precipitate the alkaloids in opium preparations, and the same is true of tannic acid and drugs containing it, such as kino and nutgall. Cinchona is incompatible with opium. The presence of a small proportion of glucose in opium renders it incompatible with silver nitrate; pills containing these two agents in combination may explode.

Incompatible with morphine salts in solution are lead, mercury, silver, and iron salts; iodine and bromides; iodides; alkalies; magnesium oxide; potassium permanganate; sodium borate; spirit of nitrous ether; Fowler's solution, and tannic acid or drugs containing it.

CONTRAINDICATIONS.—Opium and morphine are absolutely contraindicated in acute dilatation of the stom-

ach or intestines, and in conditions associated with marked respiratory impairment, such as edema of the lungs or extensive pneumonic consolidation, or with Cheyne-Stokes breathing. In infancy and in old age they—opium, especially—should be employed with unusual caution and in reduced dosage; likewise in renal disease, particularly if a tendency to uremia exists at the time.

In children, opium may be given with the following precautions: Give very small doses frequently, and state, in both the written and the verbal directions, that the child must never be awakened to take its medicine. An overdose is thus impossible. The drug is of great value to timid, highly strung children, especially in the form of small doses of Dover's powder in feverish conditions. H. S. Sandifer (Pract., May, 1907).

PHYSIOLOGICAL ACTION.—

The action of morphine is practically identical with that of opium, except in a few minor respects, and may therefore be described as representing that of the whole drug. The morphine in opium, by virtue of its greater amount as well as potency, acts about 100 times as strongly as the codeine.

Locally, morphine exerts little or no action, though if it is applied to abraded skin areas, or to mucous membranes, a slight dulling of local sensation may be noticed.

Systemic Effects.—*Nervous System.*—Morphine is a depressant to the brain, acting especially on the so-called "perception centers," whereby sensory impulses of various kinds are taken up and translated into consciousness. The reaction time to sensory stimuli is increased, and the sensitiveness to pain and other disagreeable sensations, such as fatigue, hunger, and breathlessness, blunted or abrogated. Anxiety and

nervousness are lessened and, in sufficient dosage, a powerful hypnotic effect produced. While in the ordinary subject no stage of exhilaration precedes the induction of sleep, in the habitué the imaginative powers and animal propensities are for a time enhanced before hypnosis appears. Voluntary motor activity is, in the unhabituated subject, depressed by morphine, owing to the reduced perception of stimuli. When the subject is aroused, however, the motor incapacity typical of alcoholic intoxication is manifestly not present, the patient being able to use his extremities, as well as to think and speak clearly. While a sudden, strong stimulus will arouse the morphinized patient nearly as quickly as a normal subject, slight stimuli or continuous stimuli (including persistent pain) fail completely to prevent or disturb his sleep. In some subjects, especially of the female sex or belonging to southern Asiatic races, excitement is produced by morphine instead of depression. Massive amounts of morphine or opium produce coma.

On the spinal cord morphine has but little depressant action in man, while in many other mammals a marked exciting influence is exerted by it. The medullary centers, on the other hand, are strongly affected by it in man, the respiratory, cough, secretory, and temperature-regulating centers losing their sensitiveness, while the vasoconstrictor and vagus centers are stimulated.

The combination of morphine with the other alkaloids of opium does not reduce, but rather enhances the narcotic effect of morphine upon the sensory centers in the cerebrum. The paralytic effect of morphine upon the respiratory center can be combated by the synchronous, stimulating effect of other alkaloids, no-

tably by thebaine, which in this respect acts like strychnine. The opposite holds true for the vomiting center, which is stimulated by morphine and depressed by the other alkaloids. Narcotine, narceine, and papaverine, either alone or in combination, have no effect upon the tonus of the stomach. E. S. Faust (Münch. med. Woch., Nov. 12, 1912).

Circulation.—Here the effects are, in general, not marked. Small doses may at first slightly stimulate the heart muscle (Sollmann). The vagus and vasoconstrictor centers being likewise stimulated by moderate doses, some slowing of the heart, unaccompanied by a lowering of blood-pressure because of the compensatory vasoconstriction, may be noted. Such doses tend also to relax the superficial blood-vessels, causing increased warmth and redness of the skin. Poisonous doses of morphine finally depress the circulatory system in its entirety.

Morphine, injected hypodermically, lowers the resistance and activity of the white blood-cells, though the decline is only temporary. In a subject accustomed to morphine the leucocytes are less sensitive to the poison *in vivo* than *in vitro*. In young children, who do not tolerate morphine as well as adults, the leucocytes are much more sensitive to the alkaloid. Achard (Soc. Méd. des Hôp. de Paris; Med. Standard, June, 1910).

Respiration.—Morphine is a strong depressant to the respiratory centers in the medulla, even moderate doses causing a noticeable drop in the rate of breathing, while toxic doses may lower the rate to three or four per minute. The respirations not infrequently become irregular under morphine, sometimes assuming the Cheyne-Stokes type. The sensitiveness of the respiratory centers to carbon dioxide in the blood is lowered. Death, where caused by

morphine, is generally the result of total paralysis of these centers by the drug, with consequent cessation of breathing and asphyxia. Cough is relieved by morphine through depression of the sensitiveness of the centers concerned, these centers consequently losing the capacity to respond to irritation in the bronchi.

Secretions.—Morphine diminishes the activity of all the glands except the sweat-glands, which may secrete more sweat, owing, in part, at least, to the relaxation of the skin vessels. The urinary excretion may be diminished in nephritis, but in normal subjects shows no significant change.

Alimentary Tract.—Morphine greatly lessens motor and secretory activity, both in the stomach and intestines. At the same time a tendency to tonic spasm of the pyloric sphincter is manifest, the food in the stomach being so much more digested than usual that constipation is favored. In the remaining portions of the stomach tonicity is impaired. The powerful restrictive influence on intestinal peristalsis is believed due mainly to depression of the local nerve-centers (Auerbach's plexus) in the bowel walls, as severing connections with the central nervous system fails to prevent the effect.

Report of an X-ray research on the effect of opium on the intestinal tract. Its greatest influence was on the large intestine, the food remaining in the intestine from 24 to 33 hours. The effect on the small intestine was also considerable, its action being delayed from 5 to 8 hours. The action on the stomach was more inconstant. The motility was not markedly decreased except in one case. The peristaltic motion was first stimulated and then depressed. The sphincter of the pylorus was contracted. Opium seemed to have a

more intense effect on the intestine when used in conjunction with castor oil. Mahlo (Deut. Archiv f. klin. Med., cx, Nos. 5-6, 1913).

Morphine alone is more nauseating than when given with other opium alkaloids. Even minute doses, insufficient for the relief of pain, may produce nausea. Hence it is not logical to decrease the dose of morphine to eliminate its nauseating effect. Absorption from the stomach is not apparently interfered with by morphine or opium. The secretions of the stomach are, however, markedly decreased. Morphine, after having been absorbed from the intestines, is re-excreted by the gastric mucosa. This suggests lavage as a rational measure in poisoning. The most striking effect of morphine on the stomach is the powerful tonic contraction of the pylorus, which lasts for many hours. Opium, or the total opium alkaloids, does not or do not produce such a powerful pyloric spasm. The decrease in secretion and the pylorospasm are in large measure responsible for the indigestion following the use of morphine. Macht (Amer. Jour. Med. Sciences, Dec., 1917).

The nauseant effect of morphine often witnessed is considered to be due to the formation in the system from the morphine of some body exerting an apomorphine effect upon the emetic center in the medulla. That this is the case is suggested by the fact that morphine itself acts rather in the opposite manner, hindering the production of vomiting when irritants are introduced in the stomach, owing to its central depressant action.

Eyes.—Besides impairing the sense of sight, morphine in full doses causes pronounced contraction of the pupils. Since mere instillations of morphine do not produce this, the myotic action is believed to be of central origin; the drug, according to available evidence,

stimulates the oculomotor pupil-constricting center.

Bladder.—Abolition of the micturition reflex, with or without spasm of the sphincter, may occur in morphine or opium poisoning, with resulting retention of urine.

Metabolism.—Morphine lessens metabolic activity in general, probably in the main because of the muscular quiet imposed, possibly also through the respiratory depression. Glycosuria may occur.

Temperature.—The superficial temperature may at first be raised, even by small doses, owing to the dilatation of the peripheral blood-vessels. The internal temperature, on the other hand, is generally reduced by morphine, chiefly owing to the decrease in heat production attending bodily quiet and muscular inactivity.

Absorption and Elimination.—Morphine is rapidly absorbed through the mucous membranes, including those of the alimentary tract. When administered under the skin, morphine is, peculiarly, excreted into the stomach to the extent of nearly one-half the amount taken. This excretion has been found to begin in three minutes after the injection of the drug, and simultaneous reabsorption and re-excretion of the latter from and into this organ appear to take place throughout the period of its action. About one-third of the morphine taken may be recovered from the feces. Small amounts of the alkaloid also appear in the urine, sweat, and mammary secretion, and the remainder undergoes oxidation in the system, with formation of the less toxic derivative oxydimorphine, which is in part excreted in the urine.

ACTION OF RELATED ALKALOIDS.—Codeine is much weaker as

a brain depressant than morphine, and causes sleep or allays pain only in relatively large doses. It is advantageous, however, in being less depressing to the respiration—though a good cough sedative—less constipating, and is much safer as regards habit formation upon repeated use. The dose of codeine required to allay cough has been at least six times as large, in Bastedo's experience, as that of morphine. Where pain is to be relieved, still larger amounts, *e.g.*, $\frac{1}{2}$ grain (0.03 Gm.) every four hours, must be used.

Stimulation of the spinal cord is a distinguishing property of codeine as compared with morphine. Where a dose larger than the precise amount required to produce sleep is given, the tendency to spinal excitation appears in disturbed sleep and restlessness, together with exaggerated reflexes. If the drug be given in full doses to children, spasmodic movements may even be witnessed. Codeine also differs from morphine in being excreted mainly in the urine.

Heroine, or diacetyl morphine, like codeine, is less strongly hypnotic and analgesic than morphine and is more of an excitant to the spinal cord. It diverges from codeine, however, in being relatively far stronger as a respiratory depressant, acting, in fact, much more powerfully on the breathing centers than morphine itself. There is a decided increase in the respiratory rate, with prolongation of inspiration and an increase in the force of expiration. Elimination of bronchial secretions is thereby promoted, thus aiding in the relief of **dyspnea** (Hyams). Habit formation is decidedly easy in the case of heroine, though when the habit has been acquired it can often be more readily broken—by substitution of co-

deine—than in the case of morphine. Though heroine is used chiefly to allay cough, Bastedo's systematic clinical trials, in which the effects of $\frac{1}{12}$ to $\frac{1}{6}$ grain (0.005 to 0.01 Gm.) of heroine hydrochloride were compared with those of doses of pure codeine three times as large, appeared to show a superiority of the latter, both in allaying cough, overcoming pain and promoting sleep (in **pulmonary tuberculosis**). Nausea and constipation were also noted in several instances, though, as compared to morphine, heroine is reputed to have less effect in checking secretions and peristalsis.

Heroine is more deleterious to the frog's heart than is codeine or morphine. All the alkaloids of the papaveraceous series act as depressants of the motor-nerve endings. Morphine and codeine are clearly less toxic to the motor-nerve endings than heroine, and the latter in turn is less toxic than a number of the other members of the series studied. W. Hale (Amer. Jour. of Physiol., March, 1909).

Dionin, in most of its effects, resembles codeine, and may be employed for the relief of cough or mild pain in doses of $\frac{1}{4}$ to 1 grain (0.015 to 0.06 Gm.). In addition it exhibits analgesic and lymphagogue properties when dropped in the eye. A 2 per cent. solution, thus used, produces a burning sensation, followed by pronounced edema and swelling, which begins to subside in about twenty minutes. Simultaneously a deep-seated analgesic effect is manifest, which persists for several hours and is utilized for the relief of pain in iritis, glaucoma, etc. Habit formation occurs much less easily with dionin than with morphine.

Dionin in a 1 to 2 per cent. solution is efficacious in relieving the **soreness and discomfort of the eye** so often

present in **neurotics**, apart from any demonstrable disease of the eyes. The author has also found it useful in the **pain of eye-strain**. Hinshelwood (Interstate Med. Jour., Jan., 1907).

Dionin is an invaluable drug to promote absorption of exudates in **subacute and chronic processes of the cornea and iris**. In the more concentrated solutions good results are seen in **scrofulous ulcers and torpid infiltrations of the cornea**, especially in infancy. The drug is not indicated in episcleritis and in processes with deep or extensive injections of the vessels, or during the acute stage. Absorption is hastened after extractions and discissions. Septic processes after operations and trauma may be favorably affected by dionin and alcohol dressings. A good combination in **corneal opacities** is dionin with precipitate ointment, moist heat, and subcutaneous injections of fibrolysin. In deep **corneal scars after parenchymatous keratitis** good results may thus be obtained, while **superficial maculae** will often clear up under yellow ointment in conjunction with 5 per cent. dionin. The action of miotics is considerably enhanced by the addition of dionin. The following is a good combination: Pilocarpine hydrochloride, 0.02 Gm.; eserine salicylate, 0.03 Gm.; dionin, 0.2 to 10 Gm. Zirm (Woch. f. Therap. u. Hyg. d. Aug., 37, 1910).

Peronin resembles codeine in its effects, and has been used as a respiratory sedative in **cough**. It also possesses, however, a depressant effect on the heart which renders its use less advisable than that of the other alkaloids mentioned.

Papaverine may be stated to stand midway between codeine and morphine in the quality of its action on the central nervous system, though it is relatively feeble, and does not cause profound sleep even in large amounts. According to Pal, papaverine depresses

the smooth muscle of the blood-vessels and viscera, and may be used with advantage in all conditions associated with **high blood-pressure**, as well as in **hemoptysis**; the sulphate of papaverine may be given subcutaneously for this purpose in the dose of $1\frac{1}{2}$ grains (0.1 Gm.) or intravenously in the dose of $\frac{3}{4}$ grain (0.05 Gm.).

Papaverine, reducing the tonus of smooth muscle fibers, is invaluable as an **aid to Röntgen diagnosis** in determining if an **atonic condition** of the **stomach** is due to pylorospasm, or to organic obstruction at the pylorus. An exposure is made after the patient has taken a barium sulphate suspension; then, after one day's rest, the patient receives 0.05 Gm. ($\frac{3}{4}$ grain) of papaverine hydrochloride by mouth, and a second exposure is made one hour later. Where, under the influence of the alkaloid, the delay in the emptying of the stomach was corrected, that is, the stomach again emptied itself in the normal time, the subsequent history and treatment of the cases showed that the disturbance depended upon a pylorospasm. Where the stomach emptied itself more slowly under the influence of papaverine than before, in each case an actual pyloric stenosis was found as lesion. By means of papaverine it is also possible to determine the spastic nature of an hour-glass stomach. S. Szerb and V. Revesz (Klin.-therap. Woch., March 2, 1914).

Narcotine is much less toxic than either morphine or codeine and, while resembling the latter in its effects, exerts an even greater excitant action on the spinal cord. Its own narcotic properties are very weak, but it has been shown to reinforce the action of morphine when administered with it.

Apocodeine promotes intestinal peristalsis by depressing the endings of the sympathetic or inhibitory nerve-supply to the bowel walls, and may be used

clinically for this purpose in hypodermic doses of $\frac{1}{2}$ grain (0.03 Gm.). By paralyzing sympathetic endings in general it antagonizes or prevents the actions of epinephrin (adrenalin), including that on the vessels. It has been used as an expectorant and sedative in **chronic bronchitis** and other bronchial affections.

ACUTE POISONING.—Acute poisoning by opium or morphine may occur by intent or accident, through an overdose of one of the official preparations, but not infrequently takes place through the careless use of certain proprietary medicines. Children, being very susceptible to the action of opium, are at times profoundly affected by seemingly small and appropriate doses. Soothing syrups and carminatives containing opium have contributed their share in increasing infant mortality. Idiosyncrasy, in the adult, will sometimes cause profound effects to follow the administration of a moderate dose of this drug. Among the more common unpleasant accompaniments of morphine or opium action are nausea, with or without vomiting, and itching of the skin. After-effects, such as headache, mental depression, constipation, nausea, and imperfect digestion due to impairment of gastric secretions are very frequent. Repeated use of morphine for several days may induce persistent vomiting. Occasionally a roseolar or mottled rash, with or without fever, is noted. Bastedo has reported instances of partial heart-block, suspension of breathing in tabes dorsalis, and edema of the lungs in chronic cardiac and acute pulmonary cases, as a result of administration of these drugs. At times diarrhea is

noted. In a few individuals, especially nervous women, morphine causes excitement instead of depression. Cases of idiosyncrasy to codeine with peripheral hyperemia and collapse symptoms resulting from the use of moderate doses of this alkaloid have also been reported. Many of the untoward effects of opiates can be prevented by simultaneous administration of **nitroglycerin** or **potassium bromide**.

Attention called to the nervous disturbances of respiration occurring after small doses of morphine in certain diseases—*tabes dorsalis*, sclerosis of brain arteries, tuberculosis of the mediastinal lymph-glands, and aneurism of the first portion of the aorta. C. F. Hoover (Jour. Amer. Med. Assoc., Nov. 25, 1911)

Report of 5 cases in which complete retention of urine followed a therapeutic dose of morphine. Spasmodic contraction of the pylorus has been observed in dogs after morphine, and the same mechanism is probably involved in the occasional retention of urine after morphine, the bladder sphincter closing up and the auxiliary abdominal muscles being too weak to force it. Czapek and Wassermann (Deut. med. Woch., July 30, 1914).

A poisonous dose of opium or one of its preparations is followed by a well-defined train of symptoms. There may be noticed first a preliminary stage of mental excitement, which is accompanied by a feeling of well-being and content and an acceleration of the heart's action. This is soon followed by headache, weariness, a sensation of weight in the limbs, and drowsiness. With these feelings are observed a diminished sensibility of the skin, contracted pupils, deeper and slower respiration (sometimes not more than eight to ten to the minute); slow, full pulse;

suffused or even cyanotic face, and warm, dry skin. The breathing may now become puffing and stertorous. In this stage the person may be aroused by being loudly called or violently shaken, but, if left alone, he falls asleep at once. When the patient is aroused the respirations become more frequent, the blood better aerated, and the duskiess of the face disappears. Death seldom, if ever, occurs in this stage from the action of the poison alone, but death may take place if a complicating disease be present.

If the dose taken be a lethal one, the symptoms increase in severity. The face becomes at first more cyanotic, then, as death approaches, pale and livid. The pupils contract to the size of a pin's point. The respirations now drop to 4 or 5 per minute, and become irregular and shallow. The pulse becomes weak and compressible; the skin cold and covered with a clammy perspiration. There is complete muscular relaxation; the lower jaw drops. The reflexes are abolished. The patient cannot now be aroused. Death occurs by respiratory paralysis, though at times the heart ceases its action almost simultaneously. Dilatation of the pupils is found only after or shortly before death.

Death, in the adult, has followed the ingestion of $2\frac{1}{2}$ grains (0.15 Gm.) of extract of opium, 4 grains (0.25 Gm.) of powdered opium, 1 grain (0.06 Gm.) of morphine, and 1 fluidram (4 c.c.) of tincture of opium. Taylor reports the death of a child 4 weeks of age after taking $2\frac{1}{2}$ minims (0.15 c.c.) of paregoric. The amount that can be taken without producing death by those habitu-

ated to the use of the drug is almost incredible. (For the symptoms and treatment of chronic poisoning by opium, see the section on MORPHINOMANIA at the close of this article.)

Case of severe poisoning following the injection of $\frac{1}{12}$ grain (0.03 Gm.) of heroine, a short time after an operation for chronic appendicitis. The symptoms appeared within ten minutes, the patient having the appearance of a person profoundly under the influence of an opiate. After about an hour the respiration was brought up to about 10 to the minute, but during that hour it had been very irregular, going from 4 to 8 a minute, and back to 4. The pupils were contracted to pinpoints during this time. The patient recovered. Trawick (Ky. Med. Jour., Feb. 15, 1911).

Case of a 3-month-old child whose father gave to it by mistake about 0.02 Gm. ($\frac{1}{3}$ grain) of morphine. The child went to sleep at once. An hour after, the mother became alarmed and sought aid. The stomach was washed out at once and other measures employed. Sixteen hours after the ingestion of the morphine the child was in a fairly good condition. Thus the usually assumed intolerance in infants for morphine does not always hold. This child was given more than 20 times the dose for an infant of its age. Wichura (Münch. med. Woch., July 25, 1911).

Diagnosis of Acute Opium or Morphine Poisoning.—Some cases of acute poisoning by opium bear a close resemblance to cases of uremic coma, alcohol intoxication, and cerebral apoplexy (especially hemorrhage into the pons Varolii). In all these conditions there may be coma, stertorous breathing, slow respiration and pulse, and congestion of the face. The history of the case may or may not be of assistance. In *uremic coma* there is generally more

or less edema present, and convulsions may be noted. The pupils are usually normal or dilated. The presence of albumin and casts would point to uremia, but albumin may be present in the urine after an apoplectic seizure or an intracranial hemorrhage, even though the kidneys have been in a healthy condition prior to the attack. *Alcoholic intoxication* may be suspected from the odor of spirits or of ethers on the breath or about the person. In alcoholic intoxication the patient can be roused and will answer questions. The pupils may be contracted in acute alcoholism, but will dilate when the patient is aroused. The breathing is not as slow as in opium poisoning. A hypodermic injection of apomorphine will cause a man unconscious from alcohol to vomit, but will have no effect in opium poisoning. The possibility of double poisoning by opium and alcohol should be borne in mind. In cerebral *apoplexy*, except where hemorrhage has invaded the pons Varolii, the pupils are not contracted or are unsymmetrical; there is strabismus, sometimes facial asymmetry, usually paralysis of one limb or both, and some difference in the reflexes of the two sides of the body. In apoplexy the onset of the symptoms is sudden, there is often no history of having taken food or medicine, and the face, although congested or pale, is not swelled and cyanosed as in opium narcosis. *Hemorrhage into the pons* is rare and generally fatal; the attack is sudden and the entire body is relaxed, with involuntary evacuations of bladder and bowel, which is not usual in opium poisoning. In the coma following an *epileptic convulsion* the tongue will probably be bit-

ten, the pupils dilated, and the respirations but little slower than normal. The occurrence of a convulsion at the beginning of a disturbance excludes opium poisoning.

Treatment of Acute Opium or Morphine Poisoning.—In the mildest form of opium poisoning, characterized by lethargy, partially contracted pupils, and slow respiration and heart action, the administration of **strong coffee** by mouth or rectum, with an ample supply of **fresh air**, is likely to suffice. **Stomach washing** may be instituted to lessen nausea and remove some of the toxic agent.

In the more severe cases, the first indication is to empty and wash out the stomach. **Emetics**, such as **zinc sulphate** and **mustard**—or in children, **ippecac**—may be used, but large doses will be required, and the **stomach-tube** is preferable if it can be used. By means of it antidotes can be introduced into the stomach as soon as it is washed out. **Potassium** (or **sodium**) **permanganate** and **tannic acid** are the best chemical antidotes, and a solution of one of these—preferably the former—should be placed within the stomach by means of the stomach-tube, or ingested immediately if stomach washing cannot be at once resorted to. The permanganate, if given while the poison is still in the stomach, will decompose it. A quantity of the permanganate at least equal to the amount of morphine swallowed should be administered, well diluted with water, as recommended by William Moor, who first suggested the use of this valuable measure. Subsequently the stomach should be washed out at intervals of 15 to 30 minutes with water or, preferably, a 1:1000 or 1:2000

permanganate solution. Each time some of the solution should be left in the stomach after it has been washed out, to decompose the morphine as it is eliminated into this organ. Where gastric lavage is not practicable, emesis will be assisted by having the patient take large amounts of **warm water**. Another eliminatory measure recommended is **colonic irrigation**, to remove the morphine as it is excreted into the bowel, and thus avoid its reabsorption into the system. Gilbert had success in the case of a 1-year-old child, given by mistake a teaspoonful of wine of opium, by administering as much **milk** as the child could take, followed by a tablespoonful of syrup of **ippecac**; the opium seemingly was imprisoned by the milk-clots and then removed by the emetic.

An important measure in opium or morphine poisoning is to **keep the patient awake and moving**, as this assists materially in maintaining the respiration. The heart usually being in fair condition during most of the course of the poisoning, the **patient** may be **walked up and down**, this causing increased carbon-dioxide production, with consequent stimulation of the respiratory centers. **Slapping the chest with a wet towel**, **alternate affusions of hot and ice-cold water to the nape of the neck**, **shouting in the patient's ear**, **counterirritation**, **electric shocks** or the **electric brush**, etc., are other useful procedures calculated to maintain the activity of the vital centers through vigorous peripheral stimulation. One need not hesitate to inflict considerable pain in keeping the patient awake. **Tickling the patient** is recommended by Lyne as a more efficient and less cruel measure

than flagellation; in his experience it acted remarkably, not only in wakening the patient, but angering him nearly to the point of fighting.

Respiratory activity may also be excited by the use of stimulants such as **hot, strong coffee**, given hourly by rectum, mouth, or stomach-tube, in large amounts, **caffeine** hypodermically (10 grains—0.6 Gm.—of caffeine sodiobenzoate at a dose), **atropine sulphate** ($\frac{1}{40}$ grain—0.0015 Gm.—in one or divided doses), **strychnine sulphate** or **nitrate** ($\frac{1}{30}$ to $\frac{1}{15}$ grain—0.002 to 0.004 Gm.—at a dose), and, as recommended by Pettey, **cocaine hydrochloride** ($\frac{1}{2}$ to 1 grain—0.03 to 0.06 Gm.—at a dose). **Ammonia** preparations may also be employed for purposes of rapid reflex stimulation. According to Cummings, coma in morphine poisoning is quickly overcome by the **introduction of ice into the rectum**.

Artificial respiration is of extreme importance in severe cases when the respiratory rate has dropped to 3 to 5 per minute and failure of this function is imminent. This measure should be kept up for long periods, or until the rate has risen to 8 or 10 per minute, and often saves life when persisted in. **Oxygen inhalations** may be used. Where the body temperature falls, **external heat** is indicated. **Catheterization** may be required, if there is retention of urine.

Case of opium poisoning in which the patient swallowed a solution containing about 30 grains (2 Gm.) of morphine acetate, and was not discovered until 3 hours later. In spite of **washing out the stomach**, injections of various **stimulants**, and **faradism**, cyanosis became profound, and death seemed imminent. **Oxygen** was then given and **artificial respira-**

tion commenced: 6 hours later there was a slight attempt at respiration, and at the expiration of 2 hours more artificial respiration was temporarily discontinued; 18 hours after the ingestion of the poison the patient was practically out of danger, and she ultimately recovered. D. T. Playfair (Lancet, Aug. 27, 1898).

Case of accidental administration of a fluidram (4 c.c.) of liquor morphinæ (B. P.) to a 3-month-old baby. Within 10 minutes the child was seized with violent tetanic convulsions and with periodic cessation of breathing. Pupils were contracted to pinpoint. Later the child was comatose. **Artificial respiration** was continued for 3 hours and occasionally for the succeeding 6 or 7. Within an hour the child was given $\frac{1}{300}$ grain (0.0002 Gm.) of **atropine**, subcutaneously; half an hour later, $\frac{1}{150}$ grain (0.0004 Gm.). Twice afterward $\frac{1}{300}$ grain (0.0002 Gm.) was administered. **Strong decoction of coffee** and **peptonized milk** were given by the rectum, and **fomentations** applied to the **epigastrium**. The face, the upper part of the chest, and the other accessible parts were **slapped with cold, wet towels**. The child opened its eyes at the end of 24 hours. Bronchopneumonia developed, from which recovery took place in 10 days. J. Fotheringham (Brit. Med. Jour., Oct. 22, 1898).

Case of the administration of $\frac{1}{8}$ grain (0.008 Gm.) of morphine to a baby $2\frac{1}{2}$ days old, one of the tablets intended for the mother having been given. The pulse became poor in quality and rose in rate until it had reached 160. The respirations were irregular, varying between 6 and 60. The facies became more dusky, and there were periods of cyanosis of 5 to 10 minutes in duration.

The treatment consisted in the use of **wine of ipecac**, 15 minims (0.9 c.c.) and repeated doses of **atropine sulphate**, $\frac{1}{350}$ grain (0.00018 Gm.), subcutaneously; **strychnine sulphate**, $\frac{1}{240}$ grain (0.00027 Gm.); subcutaneously;

brandy, 3 to 30 minims (0.18 to 1.8 c.c.); **suds** and **glycerin enemas**; **black coffee**, 4 ounces (120 c.c.) by rectum; **castor oil**, 1 dram (4 c.c.). On the following day there was an attack of profound cyanosis and absent respiration for one hour, during which **artificial respiration** and **oxygen** were constantly employed. Twenty-four hours after the ingestion of the drug, there was a response for the first time to external stimulation, for on pinching the cheek the head was turned away. There was a final attack of severe cyanosis some hours later, and after that the condition of the baby improved steadily. N. R. Mason (Boston Med. and Surg. Jour., Feb. 9, 1911).

Report of 2 cases of acute opium poisoning in which recovery was due in great measure to prolonged application of the **faradic current**. F. Taylor (Lancet, April 27, 1912).

THERAPEUTICS.—Opium and morphine are in widespread use for the relief of severe **pain**; to overcome **restlessness**, **apprehension**, or **insomnia** occurring in association with **severe illnesses**; to prevent the effects of **systemic strain** and **shock**, and to inhibit undue secretory activity. In **surgery**, in connection particularly with Crile's anoci-association (see Vol. VIII.) its use is distinctly on the increase.

Discussing the use of morphine during the war, the writer states that it served as an adjuvant to anesthetics, and to alleviate pain. As to the first, it appeared advantageous to restrain the shock during operations on large nerve trunks, when one cannot resort to Crile's method. When local anesthesia is resorted to, 0.5 to 1 cg. of morphine, administered before the operation was begun, yielded excellent results. The same is true of a mixture of scopolamine and morphine. The efficacy of these drugs may be increased by resorting to psychotherapy. Besides making use of mor-

phine at operations, the writer also gave it to relieve the pain of the wounded, especially when the kidneys and brain are intact. A small dose of morphine acts as a general stimulant, and not as an anodyne, as do the larger doses. Regnault (Paris Letter, Jour. Amer. Med. Assoc., Dec. 1, 1917).

To repeat all the indications of the various opiates (already submitted in the treatment of all diseases in which they are used) under this head would require about fifty pages, which the editor prefers to devote to new matter. Among the less general uses of opium and morphine may be briefly mentioned the following: (1) To check **hacking cough**, as in **acute** or **sub-acute bronchitis** and **pulmonary tuberculosis**. (2) To arrest **diarrhea**, where evacuation of the bowels, starvation, and remedies such as bismuth, astringents, and intestinal antiseptics have failed, as well as in **dysenteric conditions**. (3) To control **spasm**, especially of involuntary muscle-tissue, as in **dysentery**, **renal** and **hepatic colic**, **lead poisoning** with spastic constipation, and **bronchial asthma**. (4) To arrest **vomiting** by depressing the medullary emetic center. (5) To check **intestinal peristalsis**, as after **abdominal** or **rectal operations**, and in **intestinal hemorrhage** and **peritonitis** after the diagnosis has been made. (6) To induce sweating and alter the distribution of blood by displacement to the periphery, as at the onset of an **acute coryza** or **bronchitis**. (7) To relieve **dyspnea** or **pain** and promote general quiet and peace of mind in **heart disease**, including **angina pectoris**. (8) To allay **restlessness** in **hemoptysis** and other severe forms of **hemorrhage**. (9) To prepare the way

for **general anesthesia** by ether or other similar agent. (10) To reduce sugar excretion in **diabetes mellitus**.

Further information on the uses of drugs of the opium group is afforded in the subjoined abstracts.

In cases of **weak heart** after exhausting disease, after prolonged mental and physical pain, and without organic lesion of valves or muscle, opium is of advantage. In the gradual engorgements from **myocardial dilatation**, in **chronic parenchymatous nephritis**, and in **arteriosclerosis**, it is also of value. If the patient is hypochondriacal or hypersensitive, the second daily dose of opium invites sleep and induces a feeling of well-being. The **dyspnea of myocarditis** is relieved or prevented by continuous small doses of morphine. The **tachycardia of Graves's disease** is relieved, and in 3 cases it appeared to contribute to the cure of the disease. J. H. Musser (Amer. Jour. Med. Sci., Jan., 1906).

In the early stages of **bronchitis**, and in **laryngitis**, so often **associated with influenza**, heroine may be used for relieving the constant irritating cough, and so inducing sleep.

℞ *Heroinæ hydrochloridi* gr. $\frac{1}{6}$ (0.01 Gm.).
Acidi hydrocyanici diluti ℥ viij (0.5 c.c.).
Aquæ chloroformi
 q. s. ad ℥ ij (60 c.c.).

A tablespoonful to be taken every hour until relieved will usually give good results, and will not cause any headache or nausea the following morning. A. Bousfield (Pract., May, 1907).

Some patients who cannot take internally a dose of morphine by itself without being nauseated will take it, combined with the aromatic spirit of ammonia, without any difficulty. In the **colicky attacks** and the **gastro-intestinal catarrh of children**, opium is best given *per rectum*, mixed with a little thin starch or arrowroot, in the form of $\frac{1}{2}$ to 2 grains (0.03 to

0.12 Gm.) or more of Dover's powder or the compound kino powder (B. P.), according to the age of the child. The opium in this form is absorbed slowly and there is no risk of rapid narcotism, as will sometimes occur when a fluid preparation is used.

In acute "streaming" **coryza**, the best combination consists of $\frac{1}{4}$ to $\frac{1}{3}$ grain (0.016 to 0.02 Gm.) of morphine with 1 dram (4 c.c.) of nitrous ether, 3 drams (12 c.c.) of solution of acetate of ammonia, and $1\frac{1}{2}$ ounces (45 c.c.) of camphor water. This should be taken at bedtime, after a very light dinner, at the very onset of the attack. In a quarter of an hour the secretions will cease, the respiration become free, the soreness and aching of the eyes disappear, and a comfortable night's rest be enjoyed. The patient should be confined to his room for a day or two, otherwise, on exposure to chill, his symptoms will return. As a small dose of morphine is, in many persons, followed by very light-colored stools, from defective secretion of bile, it is often advisable to combine with it some hepatic stimulant, such as a few grains of colocynth and blue pill.

In **chronic gastric catarrh**, with much pain and nausea, and in **gastric ulcer**, it is well to combine opium with bismuth and hydrocyanic acid; or it may be given ($\frac{1}{2}$ grain of the extract—0.03 Gm.) with silver nitrate ($\frac{1}{4}$ to $\frac{1}{2}$ grain—0.016 to 0.03 Gm.) an hour before food.

In attacks of **enteralgia** or **colic**, it is useful to give a few drops of tincture of opium with a tablespoonful of castor oil; or opium liniment may be rubbed into the abdominal surface with the warm hand.

In **persistent diarrhea in infancy** and **early childhood**, the dose of opium used must be very small, and carefully graduated to the age of the child; $\frac{1}{2}$ to 1 grain (0.03 to 0.06 Gm.) of Dover's powder, or 1 to 3 grains (0.06 to 0.2 Gm.) of compound kino powder are suitable.

Small doses of codeine are of great use in some cases of **sleeplessness associated with advanced cardiac valvular lesions**.

In **acute laryngeal catarrh**, especially that form often connected with **influenza**, heroine appears to be quite as efficacious in quieting the cough as morphine, and to have the advantage of loosening the tenacious mucus.

A combination of opium and belladonna often answers well in **pulmonary tuberculosis** where **night-sweats** are brought on by coughing. In **troublesome diarrhea** in the same disease, a good plan is to give 5 to 10 grains (0.3 to 0.6 Gm.) of Dover's powder and 10 grains (0.6 Gm.) of tannic acid, mixed with 2 ounces (60 c.c.) of starch mucilage, as an enema twice daily. I. Burney Yeo (Pract., May, 1907).

In **nocturnal dyspnea in cardiac decompensation**, morphine should be given hypodermically in sufficient doses to allow the patients to lie comfortably without elevation of the shoulders. The resulting absolute bodily rest is a prerequisite to the effectiveness of cardiac stimulants. Ordinarily 3 or 4 days are sufficient to get enough improvement of the heart to allow rest at night, without morphine. LeRoy Crummer (Med. Herald, Oct., 1908).

Opium has stimulating as well as sedative properties. The stimulating action is well seen in cases of **indolent ulcers** of the skin and mucous membrane. The pale, unhealthy-looking surface becomes red and is soon covered with closely set granulations, while its secretion changes from a thin serous fluid to healthy-looking pus. This invigorating influence can be turned to account in obstinate sores occurring in cachectic children. In the **ulcerative stomatitis** common among ill-fed and badly nourished children of the very poor, which often shows little disposition to heal even when treatment is reinforced by a generous diet and healthy surroundings, a few drops (2 to 5) of laudanum, given twice a

day, quickly start an improvement which goes on smoothly to a cure.

The nervous trepidation called "**stage fright**" may be forestalled and disarmed by a small dose, 5 or 6 drops, of laudanum taken half an hour or so before the trial is to begin. The same treatment goes far to relieve the **distress of dying persons**. In inflammation of the serous membranes morphine must be freely given. It may be given to infants. For a child of 12 months $\frac{1}{40}$ grain (0.0016 Gm.) morphine may be injected, combined with $\frac{1}{100}$ grain (0.00065 Gm.) atropine in cases of **spasm**, and in half an hour the dose may be repeated if the spasm is not relaxed. E. Smith (Brit. Med. Jour., Dec. 4, 1909).

Dyspnea attended by insufficient expectoration contraindicates opium, unless expectoration is simultaneously facilitated by inhalations of steam, or of chloride of ammonium evaporated by dry heat, or by the internal use of ipecac, camphor, or benzoic acid. The stimulating effect of opium makes it a welcome remedy in the large number of **myocardial affections** which have become so frequent in **influenza, diphtheria** and other **infectious diseases**. A child of 5 years thus affected will readily and profitably take 4 daily doses of codeine, $\frac{1}{20}$ or $\frac{1}{16}$ grain (0.003 or 0.004 Gm.), more or less, through an indefinite period. Many a case of **chorea**, mainly such as are connected with endocarditis, bear and require codeine in a similar way.

Catarrhal diarrhea, follicular enteritis, and dysentery indicate opium. A baby of 1 year or less requires an average dose of $\frac{1}{30}$ grain (0.0022 Gm.) of opium as a part of its medication, once every 2 hours. That dose may be taken a long time. Dysentery requires more; particularly, if the drug is used locally, in an enema or a suppository. Tenesmus may demand the local application of larger doses. A. Jacobi (Therap. Med., Jan., 1910).

Morphine in **advanced heart disease** tranquilizes the patient, regu-

lates the heart action, and may even show a curative tendency. In 1 of the 5 extreme cases reported by the author, large doses of morphine kept up for 23 months restored the patient to a comparatively active life. He received daily from 0.02 to 0.09 Gm. ($\frac{1}{3}$ to $1\frac{1}{2}$ grains) morphine during the first 6 months, then from 0.12 to 0.34 Gm. (2 to 5 grains) daily for a year with progressive large doses of chloral. The doses were reduced gradually to nil in the course of 5 months, and the patient discharged in fairly good condition. He had 2 recurrences of the rheumatism during the following year, but compensation was maintained and the heart did not seem to suffer. Siebert (Med. Klinik, June 28, 1912).

In **diseases of the ciliary region and iris** dionin is definitely curative. A weak solution (2 per cent.) should be employed at first, but later stronger solutions (8 to 10 per cent.) may be prescribed, or even a little dionin in powder form applied to the conjunctiva, or a 10 per cent. solution injected subconjunctivally. An interval of 36 hours should be allowed between each instillation. There is only one eye condition—spring catarrh—that seems to be worse after its use. P. A. Harry (Prescriber, July, 1912).

To clear up **vitreous opacities** dionin is a valuable agent. Retinal hemorrhages are absorbed with great rapidity under its influence. In the **opacities following parenchymatous keratitis**, the relief is more prompt and certain than by the use of any other drug.

In **iritis**, when the tension is increased to the point where absorption is inhibited, the instillation of a few drops of 10 per cent. solution every half-hour for a few hours will relieve the pain and diminish the tension, and dilatation of the pupil will now follow the use of the ordinary administration of atropine. In **posterior synechia** accompanying iritis the relief of the pain is prompt.

In recent **pannus** a cure may be ex-

pected from dionin, and even in old pannus a thinning is usually seen after a few weeks. In these cases the author begins treatment with an ointment of 10 per cent. strength, and increases gradually until the powder is used. Gentle massage is applied at each sitting, together with moist heat.

Corneal ulcers healed promptly under exclusive use of the ointment. H. E. Goetz (Detroit Med. Jour., Sept., 1912).

In **cardiac asthma** heroine as a substitute for morphine has the advantage that it may be given daily for periods of weeks without losing its beneficial effects. The initial dose given by the author is 0.005 Gm. ($\frac{1}{12}$ grain), and it may be increased to 0.015 Gm. ($\frac{1}{4}$ grain). It is often of distinct advantage to combine the heroine with some form of digitalis or other cardiac tonic. Fraenkel (Therap. Monats., xxvi, 14, 1912).

MORPHINOMANIA AND OPIUM HABIT.

DEFINITION.—An irresistible craze for morphine, opium, or any of the preparations of these drugs. The term “morphinism” is applied to the symptom-complex resulting from the undue use of morphine.

SYMPTOMS.—The craving for opium or morphine is due first of all to the pleasurable sensations it excites, whether this manifests itself in the relief of severe pain—the initial cause of many cases—or to exhilaration. In the latter case the symptoms, as described by Norman Kerr, are as follows: “A few minutes after the dose, with a shorter interval when given hypodermically, the face is suffused with a blush, with probably a well-defined hectic spot. The eyes sparkle with unwonted brilliancy. The countenance is ruddy and the expression animated. This is

the stage of excitement or exhilaration. The pulse beats faster and muscular activity is increased.

"This exhilaration gradually subsides into a sense of complete happiness, satisfaction, and repose, with a slower pulse rate and muscular quietude. This constitutes the second stage.

"A vacant look, with an occasional gleam of momentary consciousness, ushers in the third stage. The opiumed person gradually sinks into a state of torpor, from which he is with difficulty aroused. The only effectual means of arousing him is to administer a fresh dose of the narcotizing agent. The face looks pale or dusky, the skin is withered, and the pupils are contracted to the size of a pin's head.

"The vascular system is relaxed in the first stage and slightly tightened up in the second, this contraction being intensified in the third. The awakening from the third stage of torpor, prostration, and apparently impending death, is wretched. Tremors are succeeded by growing restlessness, and with returning consciousness there is an overwhelming sense of intolerable uneasiness, distress, and depression, which imperiously craves for a renewal of the bewitching soporific. In this state of reaction the agony, or desperation, is sometimes so acute that suicide or homicide has been the issue."

The intense craving is thus due, not only to pleasurable phenomena experienced, but also to the relief of the morbid effects of the drug. These undoubtedly cause keen suffering.

The deterioration of the central nervous system is such as to transform completely the victim. Losing all self-control, he becomes untruth-

ful and irresolute, and even dishonest to the point of swindling, this characteristic disappearing, in normal individuals, when the opium habit is cured.

The crimes usually committed by morphinists are against property and character, and are based upon impulse and selfishness. Kleptomania, forgery, swindling, and misdemeanors of a minor class, with or without purpose, are common. One of the most marked phases of morphinism, which probably appears in most cases, is the pleasure victims take in concealing their motives and conduct. They have a mania for leading a double life and enjoy the deception and mask which they draw about themselves. Often there is egotism which makes them dangerous as witnesses, because of their positive dependence on impressions that may be fleeting and uncertain. In addition to this, the morphinist has a constantly increasing diminished ethical sense. T. D. Crothers (N. Y. Med. Jour., Jan. 27, 1912).

Mental depression, with a sense of impending evil, anxiety and restlessness become intense on withdrawal of the drug, and suicidal impulses have to be guarded against. In China, over 100,000 suicides yearly are due to opium. Anorexia, indigestion, constipation alternating with diarrhea, are usual; emaciation, a peculiar pallor or sallowness, the features appearing wizened and aged, give the patient a characteristic appearance.

When the habit is of long duration, neuralgic pains, tremors, paresis, and even ataxia may be witnessed. Such cases yield rapidly to acute diseases. Chronic dysentery, dyspeptic and neuralgic pain, a harassing cough, evanescent albuminuria during the exhibition of the drug, and also after its discontinuance have been noted.

Cirrhotic and nephritic disorders are infrequently seen with opium.

Morphine can be detected in the urine. The latter, in morphinomania, reduces sulphate of copper if heated with caustic soda, and gives, although slowly, an abundant precipitate of copper oxide, while polarization and fermentation give a negative result.

When smoked, opium is more quickly absorbed than when eaten, but it is less harmful, as only a comparatively limited quantity can be inhaled at a time. With the latter mode of use there is greater disorder of digestion. Opium drunk in a liquid form may be classed alongside opium taken as a solid. The speedier absorption of laudanum is more than counterbalanced by the smaller quantity that can be taken on account of the larger bulk. The hypodermic injection of morphine is, however, the most swift and the most potent of all the methods of administration. The effect is almost immediate.

No one can describe the torture experienced by opium inebriates on the failure of the supply of a fresh dose at the accustomed time. On receiving it, the patient will at once become lively, clear-headed and brilliant on the exhibition of a sufficient dose. This depraved physical state is a pathological condition—a physical depression which clamors for a renewal of the potion as soon as the pleasurable effects of the preceding dose have disappeared.

A common feature of all narcotic inebriety, according to Kerr, is the frequent perversion of the affections. Love is transformed into hate, and the narcomaniac not unseldom loathes the sight of the devoted companion whom, in his prenarcotic years, he

cherished with the tenderest affection. Opium transforms the manly, high-toned, pleasant companion into an effeminate, driveling, querulous bore.

DIAGNOSIS.—The opium slave is recognized by his glazed eye, hollow cheeks, wasted frame; dry, parchment-like skin; slothful habit, and livid countenance; the opiomaniac and morphinomaniac are often difficult of detection, if they have a supply of the drug about them. The pupil is not a reliable guide, since it is only contracted under the direct influence of the drug. Most of the time, particularly in advanced cases, it is dilated. Severe persistent pain in the epigastric region, yielding after a few days of abstinence, has been noted by Kerr.

Symptoms suggesting malaria are occasionally seen, both during the presence and absence of the narcotic. There are high temperature and shivering, like the cold and hot stages of intermittent fever. There is also an opiate and morphine “trembling delirium,” exclusive of the acute wakeful and trembling delirious state supervening on sudden withdrawal. The temperature is lowered in alcoholism, but is slightly raised by opium.

ETIOLOGY.—Opium or morphine inebriety is often the result of careless administration of the opiates to patients for the relief of pain or insomnia, and, in physicians, to their heedless use on themselves. Indeed, the medical profession seems to afford the greatest number of victims. Of 545 morphinomaniacs mentioned by Lacassagne, 289 were doctors.

Nearly every case of morphine addiction is traceable to medical advice in some chronic affection. The

patient should never be allowed to know the nature of the drug with which pain is alleviated. Morphine should be used only as a last resort, and given internally. If the syringe has to be used, injecting such a dose that a single one suffices should be the rule, and the syringe must never be given to the patient. If these rules for prophylaxis of morphine addiction were printed and given to young physicians on graduation, morphine would have far fewer victims. Mueller (Berl. klin. Woch., Dec. 7, 1909).

A very short time suffices for the establishment of opium inebriety. It is readily set up in from four to six weeks. It cannot lay claim to great indebtedness to direct heredity, though its descent through three generations has been observed. In a substantial proportion of opium cases both the inebriate and neurotic inheritance has been traced, in some instances one and in other instances both forms of transmission being present. Under favoring circumstances the progeny of opium drunkards have exhibited a tendency to alcoholic excess, and the children of alcoholists to opiate intemperance.

The number of babies forced into the opium habit is appallingly large, owing to systematic drugging with opium in the form of paregoric or soothing syrup. An infant may become as firmly addicted to opium as an adult, and feels as keenly its withdrawal.

PATHOLOGY.—The pathological changes which have been observed in opiumism are few and limited. The repeated contraction of the vessels impairs the nutritive processes. When the opium habit has become a disease it alters nutrition and perverts vital function.

Morphine overstimulation does two things, namely, first, it provokes perversion of metabolism and, second, a secondary exhaustion fatigue. Fatigued nerve-cells mean catabolic insufficiency and formation of acid which further exhaust the ganglion cells by establishing a change of chemistry within the cells. Fatigue acid formation, for the time, makes overdrafts on the cell energy and results in reactive morphine depression and exhaustion. In healthy fatigue acid formation there is chemical compensation and elimination without resulting molecular damage; but in the continued, permanent, residual fatigue of morphinism a more or less constant acid polarization of the cell takes the place of the normal alkaline cellular chemistry. S. Grover Burnett (N. Y. Med. Jour., Feb. 8, 1913).

PROGNOSIS.—Opium transcends alcohol in the generation of a more irreclaimable and incurable diseased condition. Cured opium inebriates are comparatively fewer in number. It is much more difficult to abandon the opium than the alcohol habit.

The mere withdrawal of the drug is in no way an adequate treatment for the condition; it is necessary to continue the most careful treatment for many months before the patient can be discharged. No cure can be considered as reasonably permanent until from three to five years have elapsed since discharge without return to the use of the drug. One of the writer's patients was addicted to the new drug, pantopon. H. Koenig (Berl. klin. Woch., June 8, 1914).

TREATMENT.—In morphine inebriety, in whatever form the narcotic has been taken, it is desirable to **withdraw the poison** as speedily as may be practicable; but the difficulty lies in the practicability. Among distressing symptoms after sudden withdrawal, the following have been

observed in an aggravated form: Rigors, nausea, vomiting, exhausting diarrhea, convulsions, delirium, prostration, and collapse. Languor and sneezing are minor troubles. The agony is in many cases indescribable, and the symptoms are so alarming that the full narcotic dose of the drug has had to be given to avert a fatal issue.

All this suffering may be averted, however, by using **hyoscine hydrobromide** hypodermically as a temporary substitute. The dose should be small at first— $\frac{1}{200}$ grain (0.0003 Gm.); this is then gradually increased until $\frac{1}{100}$ grain (0.006 Gm.) or more is administered. Morphine and strychnine being ready antidotes, no fear need be felt of dangerous effects. The painful symptoms attendant upon the abrupt withdrawal of morphine have a natural limit of a few days' duration. By the use of hyoscine these days may be passed in comfort, and the patient enabled to escape the nerve-strain and shock that would necessarily have attended such an ordeal of suffering.

No remedy for any disease fills an indication more perfectly or gives better results than does **hyoscine** in the treatment of morphinism. The gradual reduction method of treating morphinism should be discarded as useless and even hurtful; the sudden withdrawal, without some agent to relieve the patient's suffering, is inhuman and dangerous. This leaves the **rapid reduction** as the only one of the old methods worthy of consideration, but in this the patient suffers so intensely and the result is so seldom a cure that it certainly cannot be regarded as a satisfactory or successful treatment.

In a series of nearly 400 cases in which the writer has used this remedy he states that only in 2 or 3 cases has

delirium or delusions of any kind been present as long as forty-eight hours after the last dose. Probably, in 1 case out of 10, such symptoms continue twenty-four hours after the last dose, but in fully 90 per cent. of the cases the mind was perfectly clear by the twelfth hour or earlier, and remained so thereafter. In many cases the delirium subsides by the fourth to sixth hour after the last dose. G. E. Pettey (Med. News, Feb. 28, 1903).

The narcotic method of treatment used by the writer consists in the giving of various **hypnotic remedies**, so combined or alternated as to keep the patient asleep or in a quiet or comfortable condition for a short time, while the morphine is being completely withdrawn. When he awakes the period of suffering is passed, and all desire for morphine is gone. The painful part of the morphine withdrawal is accomplished while the patient is unconscious, on the same principle that a surgical operation is performed under the influence of anesthetics.

The hypnotic remedy most often recommended for morphinism is **hyoscine**, administered in large and repeated doses. The author considers this plan of treatment too uncertain to be recommended as a routine measure. While it may answer as an exclusive remedy in some cases, yet usually it produces delirium, and occasionally the delirium lasts for some time after the administration of hyoscine has been stopped. He has, however, often found it useful as an adjuvant to other sedative remedies, but many patients do not bear it well, and are made worse by its exhibition if it is not combined with other remedies. The exact remedy or combination of remedies must be determined by the idiosyncrasy of the patient, and occasionally several combinations will be tried before the one best suited to the peculiarities of the patient in hand is found. But with experience the physician will be able to get his patient promptly into the right condition for a total withdrawal

of morphine, without pain and without danger. C. J. Douglas (Med. Rec., Sept. 14, 1907).

Although many advise immediate discontinuance of the drug, this plan, the author remarks, has so frequently been followed by temporary insanity or collapse that it seems more advisable to avoid the system of rapid withdrawal in greatly debilitated cases. **Rapid withdrawal** has the advantage that, while it may cause severe suffering for a few days, it does not greatly prolong the agony.

Most patients will be found taking from 10 to 15 grains (0.6 to 1 Gm.) a day. One is fairly safe in cutting the maximum in half the first day of treatment, as most habitués take almost double the quantity necessary for comfort. One may cut this quantity in half the following day, and so day by day until none at all is being used, excepting when symptoms of collapse supervene and one is forced to use a small quantity temporarily. F. McK. Bell (N. Y. Med. Jour., April 8, 1911).

The writer favors **rapid withdrawal** and warns against attempts to substitute another alkaloid for the morphine. In the rapid cure, lasting about ten days, the addition of **scopolamine** to morphine is recommended, because it is possible from the very beginning to get along with smaller doses of morphine. The withdrawal cure is always successful when the patient adheres to the treatment faithfully. The important thing is to prevent a relapse. Only when the personality of the patient has been improved, when his will-power has been strengthened, and when he has been made strong and free from within, can the task be considered as solved. Months and years are necessary for this psychic influence and control. A. Friedländer (Med. Klinik, Sept. 28, 1914).

Where hyoscine hydrobromide is not available, **potassium** and **sodium bromides** are indicated to subdue the extreme nervous irritability, with

hyoscyamus and **cannabis indica**. The quantities administered must vary in the individual cases.

A daily morning **hot pack**, lasting 2 to 3 hours, is continued for 8 to 10 days. The diarrhea which follows the **immediate withdrawal** should not be checked. One ounce (30 c.c.) of **sodium phosphate** is given daily, until the desired depletion has been secured, and then 1 dose of **castor oil** given. A **single dose of morphine** early in the treatment may be required if there are signs of collapse. The treatment never has to be continued longer than 10 days. H. Mason Smith (Jour. Fla. Med. Assoc., Jan., 1916).

Dangerous acid intoxication may arise during morphine withdrawal, and may be an element in sudden collapse. This may be avoided by giving enough **sodium bicarbonate** to keep the urine neutral before beginning the reduction of morphine. J. E. Talley (Trans. Amer. Med. Assoc.; N. Y. Med. Jour., June 9, 1917).

To stimulate and brace the heart, **digitalis** and **strophanthus** are invaluable. **Sparteine** may be administered hypodermically, and **nitroglycerin** is given in tablets or, better, the 1 per cent. alcoholic solution.

In opium inebriety there is often severe and prolonged vomiting during the earlier stages of gradual treatment, especially if the latter be adopted. This is avoided by beginning the treatment with a **calomel** purge followed by a **Seidlitz powder**.

While many physicians treating narcotic drug addiction depend entirely upon saline cathartics to empty the intestinal tube, these cathartics alone do not give satisfactory results, allowing considerable quantities of toxic matter to remain, the presence of which accounts for the nervousness, nausea, and other distressing symptoms from which patients thus treated suffer. The following are

given as examples of physiologically balanced purgative combinations:—

℞ *Hydrargyri chloridi mitis*,
Extracti rhamni
purshianæ, āā gr. x (0.6 Gm.).
Ipecac. pulv. . gr. j (0.06 Gm.).
Strychninæ ni-
tratis gr. $\frac{1}{8}$ - $\frac{1}{6}$ (0.008-0.01 Gm.).
Atropinæ sul-
phatis gr. $\frac{1}{50}$ (0.0012 Gm.).

M. et ft. capsulæ no. iv.

Sig.: One every two hours, preferably at 4, 6, 8, and 10 P.M., fasting.

In all patients addicted to a narcotic drug, the strychnine in each of the foregoing formulæ should be increased to the extent of from 50 to 100 per cent.

The following pill is considered by the author one of the best of its kind:—

℞ *Aloini* gr. ss (0.03 Gm.).
Strychninæ ... gr. $\frac{1}{60}$ (0.001 Gm.).
Extracti bella-
donnæ foli-
orum gr. $\frac{1}{8}$ (0.008 Gm.).
Ipecacuanhæ
pulveris gr. $\frac{1}{16}$ (0.004 Gm.).

M. et ft. pilula no. j.

G. E. Pettey (Narcotic Drug. Dis. and Allied Ailments; N. Y. Med. Jour., Aug. 29, 1914).

As a specific, Lambert recommends the following formula, which has been found effective by a large number of observers:—

℞ *Tinct. of belladonna* .. f̄ij (60 Gm.).
Fl. ext. of xanthoxylon,
Fl. ext. of hyoscyamus,
of each f̄ij (30 Gm.).

The treatment should be started by giving 4 compound **cathartic pills**, 5 grains (0.3 Gm.), of **blue mass** and a **soapsud enema**. When catharsis begins 6 to 8 minims (0.36 to 0.5 c.c.) of the above mixture are given every hour. The dose is then increased 2 minims (0.12 c.c.) every 6 hours, until 14 to 16 minims (0.84 to 1 c.c.) are taken hourly or the patient begins to show toxic effects, when the mixture is stopped, resuming again in 8-minim (0.5 c.c.) doses

hourly, when the toxic effects subside. **Morphine** is given besides the belladonna mixture, but only $\frac{1}{2}$ or $\frac{2}{3}$ of the dose which the patient has been taking, and in 3 equal doses at half-hour intervals. The bowels must be kept open. After about 30 hours, **strychnine**, **digitalis**, or **strophanthus** should be begun. This treatment removes the desire for morphine (also cocaine and alcohol) in about 5 days. EDITORS.

New method. The patient is put to bed and his morphine stopped entirely. He is put on semisolid or liquid diet and is given **cathartics** as prescribed in the Towns-Lambert treatment. He thus receives 3 or 4 cathartic courses, consisting of 5 grains of blue mass with 5 compound cathartic pills at intervals of 18 hours. Some hours after the last cathartic course he is given **castor oil**. In addition the patient receives from 2 to 4 intravenous infusions a day of 1000 c.c. of 0.9 per cent. **saline solution**. During the first few days the patient is given enough **chloral** at bedtime to ensure a night's sleep, and to blot out large periods of discomfort and fortify him mentally and physically. The liquid diet is continued as long as the patient feels any nausea, and he is kept in bed during the cathartic period and until all acute discomfort from the withdrawal of morphine has disappeared. The patients showed no ill effects. Repeated infusions do not produce anemia. It was not found necessary to give cardiac stimulants to any of the patients. Bluemel (Jour. A. M. A., Feb. 22, 1919).

Ice, milk and lime-water, or milk and soda-water will aid in counteracting the vomiting.

In all cases great attention should be paid to the **diet**, which should be **nourishing**, easy of digestion, and such as will not be rejected by the stomach when the appetite improves.

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OPTIC NERVE AND RETINA, DISEASES OF THE.—The optic nerve and the retina, forming, together, an offshoot of the central nervous system, show the closest association in their diseases, which are largely dependent on general disease and disease of other organs. Being open to inspection and minute investigation, they furnish valuable diagnostic and prognostic indications regarding the conditions with which they are associated.

RETINITIS.—Retinitis is an inflammation of low grade and extremely chronic. Heat and pain are absent, redness is often confined to doubtful changes in the retinal vessels, and swelling is evident chiefly through the opacity of the exudate.

SYMPTOMS.—Impairment of vision is the only constant subjective symptom; and it is not characteristic, and tells little of the cause or gravity of the disease. In the early stages it appears as a diffuse clouding of the field of vision or some part of it. Later it may be a distortion of objects (*metamorphopsia*) or an annoying quivering of the thing looked at. In some forms impairment of vision is greatest by a bright light: *day-blindness*. In others it is greater by feeble illumination: *night-blindness*. Flashes of light sometimes occur, but they may not be noticed at all. The important symptoms are wholly ophthalmoscopic. They include opacity of the retina, alteration of the retinal vessels, hemorrhage, and pigment deposits and alterations.

Opacity hides the retinal pigment-layer, and the color or details of the choroid, which are visible through the normal retina. The opacity may appear as a gray veil, blurring or en-

tirely obscuring the deeper structures, or it may have the form of definite dirty-white, or clear, glistening-white masses. Its effect on the retinal vessels varies with their depth in the retina. A vessel running on the surface of the retina is more distinctly seen than normal, because of the contrast furnished by the gray or white opacity of the retina behind it. But a portion of a retinal vessel imbedded in the retina will be partly or entirely hidden by the opacity.

The retinal vessels may be distended uniformly or irregularly. Distention renders the visible vessels larger, and more of the small vessels visible; and it also makes the vessels more tortuous. The tortuosity is shown both by the wavy outline in the plane of the retina and by more decided differences of level in different parts of the vessels; so that some parts stand out with greater distinctness, while others are comparatively buried in the depths of the retina. Irregular distention of the retinal veins occurs in retinitis, indicating disease of the vessel walls.

Retinal hemorrhage is liable to occur in violent retinitis of any kind, causing dark-red spots in the fundus. When it takes place into the nerve-fiber layer, the blood becomes diffused in the direction of the bundles of fibers, forming what are known as “flame-shaped” patches, narrower toward the optic nerve, wider and having a “feather-edge” in the opposite direction. In time the dark-red spot of hemorrhage disappears. It may be followed by a patch of white or a marked disturbance of pigmentation.

Subhyaloid hemorrhages are large, rounded areas of hemorrhage, located near the posterior pole of the eye,

and often shifting their positions from day to day, situated between the retina and vitreous. They undergo absorption with, sometimes, full restoration of vision.

Pigmentation.—Patches of retinal inflammation are often followed by atrophy of the retinal pigment-layer or the formation of black pigment-blotches. These develop slowly and may become visible when the inflammatory opacity and swelling have so far subsided as to permit a view of deeper structures; or, in the more chronic forms, there is a slow migration of pigment-cells which may accumulate around the retinal vessels.

VARIETIES.—Simple or serous retinitis may be caused by eye-strain, choroidal inflammation, or obscure constitutional conditions. It may be limited to small, isolated areas. The affected parts of the retina appear gray or bluish, with indefinite edges. It affects one or both eyes.

Purulent retinitis results from injury, as a penetrating wound or the lodgment of a foreign body in the vitreous; or, it may be a *septic, metastatic*, or *embolic* retinitis, arising in connection with pyemia, puerperal fever, etc. It may present only small, white spots, and hemorrhages scattered throughout the retina; or it may be indistinguishable from purulent choroiditis, ending in panophthalmitis or in chronic purulent accumulation in the vitreous: *pseudoglioma*.

Renal retinitis commonly attends chronic, non-exudative, or interstitial nephritis. (See BRIGHT'S DISEASE, volume ii.) It arises in connection with severe toxemia, or with advanced disease of the retinal vessels. It is not an early symptom, but it is often the first symptom that leads to a cor-

rect diagnosis. It often presents a characteristic appearance, consisting of white dots, arranged somewhat in lines that radiate from the fovea. There are retinal hemorrhages, usually "flame-shaped," and irregular dilatation of retinal veins. The optic nerve may be involved in the inflammation. There may also be extensive masses of retinal exudate. Both eyes are commonly affected. The appearance of this form of retinitis in chronic Bright's disease commonly indicates a fatal termination of the case within a year or two. To this rule there are many exceptions among patients who are well-to-do and can control the conditions under which they live, avoiding strain, exposure, and unsuitable diet.

The retinitis of pregnancy closely resembles renal retinitis; but if the pregnancy is promptly terminated, partial or complete recovery usually ensues.

A woman eight months pregnant who seven weeks before had toxic headache, vomiting, etc. Three weeks later both eyes were blind. When labor was induced the child was dead and the mother died of toxemia. D. Roy (Ga. Med. Assoc. Jour., Feb. 11, 1913).

Leukemic retinitis occurs in leukemia and pernicious anemia. (See ANEMIA, volume i.) The whole fundus may be obscured by the retinal swelling, and often has a markedly yellowish color. Retinal hemorrhages are numerous and the retinal veins may be enormously dilated, while both arteries and veins are comparatively pale. Both eyes are affected.

Hemorrhagic retinitis, or **retinal apoplexy**, is marked by hemorrhages in all parts of the retina, which recur again and again. It depends on

thrombosis of the retinal veins. Vision is greatly impaired, and hemorrhagic glaucoma is likely to ensue. One eye is likely to be affected earlier, or to a much greater extent than the other.

Gouty retinitis occurs in elderly gouty persons. There are yellowish-white patches of exudation. The vessels are irregularly narrowed, with thickening of their walls. In the early stages there are hemorrhages. Impairment of vision is progressive, but rarely goes on to complete blindness. No sharp line can be drawn between the conditions of renal or gouty retinitis, and the retinal changes of arteriosclerosis.

In 45 per cent. of the writer's cases 1 eye was involved, while both were involved, one soon after the other, in nephritis. It is also far more chronic than nephritic retinitis. The retinal changes throw light upon the state of the cerebral vessels. The writer found in 70 per cent. of a series of cases of hemiplegia signs of retinal arteriosclerosis, and, conversely, in his series of retinal arteriosclerosis 46 per cent. suffered from cerebral hemorrhage or thrombosis within a period of 3 years. Moore (*Quar. Jour. of Med.*, Oct., 1916 and Jan., 1917).

Diabetic retinitis is characterized by ivory-white dots of exudation—most numerous near the posterior pole of the eye, but not grouped in any special figure—and points or larger spots of hemorrhage. (See **DIABETES MELLITUS**, volume iv.)

Syphilitic retinitis is one of the late secondary lesions. It is commonly attended by choroidal disease and dust-like opacity of the vitreous. The retinal exudate may be localized, especially at the macula or in a zone around the optic disk. Vision is always permanently impaired. The

optic disk may be at first red and swelled; and later undergo atrophy, becoming yellowish in color, with narrowed retinal vessels.

Punctate retinitis shows numerous white or yellowish-white points scattered throughout the fundus, with some impairment of vision. It is probably the permanent condition following some active disease, or any early change that later passes over into retinitis pigmentosa.

Circinate retinitis is characterized by a wreath of brilliant white spots near the macula or the optic disk, or including both these regions. This appearance is preceded by retinal hemorrhages. Vision is permanently impaired through changes that always involve the macula. These are permanent, although the brilliant white spots may entirely disappear.

Striate Retinitis.—In this form of retinitis yellow or gray lines or streaks appear in the retina. Sometimes they are straight, as if drawn upon; in other cases curved, but not conforming to any normal structure. They may follow detachment of the retina, if the detached portion resumes its normal position.

Proliferating retinitis includes cases in which masses of opacity, probably following large hemorrhages, extend from the retina into the vitreous humor.

Retinitis from excessive light occurs after looking at the sun without sufficient protection, as after watching an eclipse. A small central scotoma occurs, attended and followed by persistent dazzling and metamorphopsia.

After the eclipse of April, 1912, fully 3500 such cases occurred in Germany. Of 188 cases 55 showed

slight changes in the macula, and in 49 there were marked pathological alterations. There was a scotoma, central in 128 cases, paracentral in 6, oval in 4, crescentic in 4, ring scotoma in 2 and star-shaped in 1, but in the mass of cases round. It varied in size from less than one-half degree to one degree. Werdenberg (*Zeit. für Augenheilkunde*, vol. xxx, p. 273).

After exposure to the arc electric light at a short distance the same trouble may develop; but it is at first attended with smarting, burning, and swelling of the conjunctiva, probably dependent on the short wave radiations that reach the conjunctiva, but not the deeper structures of the eye, from the arc light.

Retinitis pigmentosa is a condition of retinal degeneration, usually congenital. It is characterized by night-blindness, great narrowing of the visual field, the deposit of pigment-masses in the retina, narrowing of the retinal vessels, and atrophy of the optic nerve. The pigment-spots are branching, often the shape of bone-corpuscles. They appear first and are most numerous in the periphery of the fundus. The night-blindness is commonly noticed in early childhood, and the disease is slowly progressive until at the age of 60 most cases end in complete blindness. Sometimes a very similar condition, but running a more rapid course, occurs in tertiary syphilis. In a few cases, otherwise similar, no pigment-deposits occur. The degeneration of the retina depends on a sclerosis of the smaller or superficial vessels of the choroid causing atrophy of the layer of rods and cones. The pigment spots are due to the migration of pigment-cells, which often come to form a wrapping around the shrunken retinal vessels.

Amaurotic family idiocy is attended with a white opacity of the retina about the macula, with a red spot in its center, and blindness soon becoming complete from degeneration of the nerve-cells of the retina. It comes on during infancy or early childhood, with general asthenia due to similar changes in the cerebral cortex.

Angioid streaks in the retina, brownish streaks of pigment-deposit which have the shape of a vascular network, but which do not conform to the visible retinal or choroidal vessels, mark a special form of a retinal degeneration. Vision is impaired, and the streaks are preceded by retinal hemorrhages.

DIAGNOSIS.—Retinitis must not be confused with blurring of the retinal vessels and other details of the fundus due to errors of refraction, especially regular astigmatism. Blurring from an error of refraction affects all parts of the fundus, or all parts of the retinal vessels running in a certain direction. Retinitis affects only certain portions of the fundus, or some parts more than others, and veils the vessels running in one direction no more than those running in another. The haziness caused by dust-like, localized opacities of the vitreous simulates that of retinitis. Patches of serous retinitis may closely resemble detachment of the retina. The appearance of the retinal vessels upon the surface, with prominence of the swelling and the involvement of a large area, indicates detachment.

Retinitis is generally followed by degenerative changes, and many of the symptoms characterizing its various forms are really degenerative. The diagnosis between the different varieties is indicated in their de-

scription. In determining the form of the retinitis other symptoms of the underlying general condition should also be sought for and carefully considered. Thus renal retinitis may be exactly simulated by the retinal symptoms of organic disease of the brain; and only the renal or the cerebral symptoms can establish the diagnosis.

PROGNOSIS.—This depends on the cause of the retinitis. Simple inflammation from eye-strain may end in complete recovery. Purulent retinitis commonly destroys the eyeball, but the form characterized by small, white spots may go on to incomplete recovery. Albuminuric and leukemic retinitis may improve under treatment, but they partake of the grave prognosis of the underlying diseases. Toxemic retinitis arising during pregnancy may undergo very marked improvement. Retinitis pigmentosa goes slowly on to hopeless blindness. Other forms of retinitis rarely cause complete blindness; but vision once lost through them is not regained, or is only partly recovered.

TREATMENT.—Rest for the eyes and avoidance of bright light and sudden changes of illumination are important, in the active stages of retinal inflammation. Rest must include the use of lenses correcting any ametropia, and may require the use of colored glasses or a cycloplegic. Removal of the cause or appropriate treatment of the underlying dyscrasia comes next in importance. After the acute stage has passed, the retinal degeneration succeeding it is best met by tonics, and especially strychnine, in doses ascending to near the limit of physiological tolerance. Retinitis pigmentosa requires a very moderate use of the eyes and the tonic treatment

throughout. Instillations of a weak solution of **physostigmine** may be employed; and the application of a weak **galvanic current**, $\frac{1}{4}$ to 1 milliampère, has been credited with benefit.

RETINAL VASCULITIS AND PERIVASCULITIS.—Great impairment of vision, often arising from hemorrhage into the retina or vitreous, calls attention to disease of the retinal vessels. Often the hemorrhage and opacity caused by it hide the changes going on in the vessel walls. When these are seen they are blurred or covered by the exudate; parts of the veins may be greatly dilated or tortuous; parts of the arteries entirely hidden by gray masses in which new-formed vessels arise. Sometimes the retina is greatly thickened. These cases have been known as cases of massive exudation into the retina. Others are marked by repeated hemorrhages, the recurring hemorrhages of early life. Some cases are due to *tuberculosis* of the retinal vessels, although evidences of the disease in other organs may be slight or entirely wanting. These cases are shown by a positive general or local reaction to **tuberculin** injections, and may be cured by therapeutic doses continued once a week for several months.

RETINAL ANGIOMATOSIS (von Hippel's disease) is characterized by rounded red bodies in the retina into each of which enter one or more dilated arteries and dilated veins. One part of the retina after another is affected, and the case ends in blindness, retinal detachment, and glaucoma.

RETINAL ANGIOSCLEROSIS.—The changes in the retinal vessels revealed by the ophthalmoscope are

often the earliest evidence of arteriosclerosis. The arteries become narrowed or irregular in caliber, and the blood-stream may be hidden by opaque-white patches in the vessel wall. The veins become irregularly dilated and tortuous; but where they are crossed by the arteries are hidden on each side of the artery, narrowed, and abruptly bent or "kinked." White lines may run parallel on either side of the vein, or parts may be hidden by patches of opacity in the walls.

EMBOLISM AND THROMBOSIS OF THE CENTRAL RETINAL ARTERY.—These cause sudden blindness of one eye, usually permanent.

Symptoms and Diagnosis.—There is general haziness of the retina, most intense near the posterior pole of the eye, with a dark-red spot at the macula. When one or more branches of the central artery escape obstruction, a corresponding portion of the field of vision is retained. When the macula is supplied by a cilioretinal artery, full central vision may be preserved. At first the retinal arteries retain their normal appearance, while the veins are usually narrowed or partially collapsed. Later both arteries and veins become greatly shrunken, and the optic disk white and atrophic. The two conditions are to be distinguished from each other chiefly by the presence of some probable source for the embolus in embolism; or preceding symptoms of vascular disease, as brief obscurations of vision, for thrombosis.

Prognosis and Treatment.—In thrombosis the recovery of vision is very improbable. In a few cases of embolism some vision is recovered. Either spontaneously or under treat-

ment the embolus may be broken up and pass onward into some branch of the artery, and even into such peripheral branches that its effects are no longer noticed. To favor such a termination the **inhalation of amyl nitrite** may be pushed to a decided physiological action, and active **massage of the eyeball** employed. These should be repeated daily for several days before abandoning hope of improvement. If the embolus is dislodged, **strychnine** may be indicated to promote restoration of the retinal function.

THROMBOSIS OF THE CENTRAL RETINAL VEIN causes blindness, less sudden and complete than that due to the obstruction of the artery. It is attended by dilatation of the retinal veins and hemorrhages throughout the retina, and may be followed by hemorrhagic glaucoma. The treatment is that of the general condition accompanied by the retinal disease.

DETACHMENT OF THE RETINA is a displacement of the retina from its normal position. This may be caused by a tumor or by a displacement of the choroid. But the term is commonly understood to mean a separation of the retina from the choroid by serous fluid.

Symptoms.—There is impairment of vision often sudden, and affecting but a portion of the visual field. Commonly a subretinal effusion settles to the lower part of the eye, so that the upper part of the field of vision is lost. The detached portion of the retina may float in front of some part still normal, causing sudden temporary loss of vision. With the ophthalmoscope a gray veil is detected, hiding more or less completely

the normal red of the eyeground. It presents rounded folds, which float, as the movements of the eye disturb the fluid beneath. These folds are more hyperopic or less myopic than the undetached parts of the retina that may be seen above them. On the folds may be traced the retinal vessels, appearing very small and dark in color.

Diagnosis.—The rounded gray folds with the retinal vessels on them are unmistakable. It is sometimes more difficult to decide if the case is one of simple detachment or one of detachment due to new growth. Movement of the folds of retina, after moving the eye, indicates that it is floating freely on serous fluid. When attached to a choroidal growth no such movement occurs; and the vessels of the growth, resembling choroidal vessels, may be seen through the retina. When a new growth exists, but the retina is separated from it by serous fluid, the growth may be perceived through the retina by making the ophthalmoscopic examination with direct sunlight; or transillumination of the eyeball may give evidence of a subretinal tumor, usually a sarcoma of the choroid or ciliary body. The tension of the eyeball may throw some light on the case, being normal or below in simple detachment and sometimes elevated in cases of tumor. The recognition of detached retina accompanying cataract is important as influencing the prognosis regarding the results of operation. It must depend chiefly upon the careful testing of the field of vision.

Etiology.—Blows on the eye or head may cause detachment of the retina, either primarily or as the re-

sult of other changes in the eye. Very myopic eyes are especially liable to it, and the liability increases with age. Extensive changes in the vitreous, especially cicatricial contraction, may pull the retina away from the choroid. Sometimes a tear may be recognized in the detached retina, apparently due to such traction. Through it the choroid may be clearly seen with the ophthalmoscope.

Prognosis.—A small proportion of patients recover spontaneously. This most frequently occurs in traumatic cases. In a large proportion of cases no treatment will effect the permanent replacement of the retina and restore sight. There is no hope of cure for eyes having excessive myopia or great alterations of the vitreous.

Treatment.—An opening through the sclera permitting the subretinal fluid to escape externally, with or without an opening through the detached portion of the retina to allow it to pass freely into the vitreous, has usually caused a temporary improvement in the detachment; in a very few cases it has afforded permanent relief. But in most cases the detachment has recurred, and there has been no permanent benefit. The burning with the **galvanocautery** of one or two holes in the sclera that will close only after several days or weeks is claimed to be more efficient. The greatest chance of permanent restoration is given by **prolonged rest in bed**, with the eyes covered most of the time with a **pressure bandage**; and the use of **pilocarpine sweats** and **potassium iodide** or **salicylic acid** internally. But this must be persisted in for several weeks to render the benefit permanent; in a large proportion of cases it fails to do good.

Sometimes a **part of the distended sclera** has been **excised**, reducing the enlarged eyeball so that the retina will be pressed against the choroid by the vitreous, the force which normally keeps it in proper position.

GLIOMA OF THE RETINA—or, more strictly, **gliosarcoma of the retina**—is a malignant new growth occurring in early childhood.

Symptoms.—Attention is usually first attracted by the appearance of a yellowish reflex in the somewhat dilated pupil, and the eye is found to be blind. On examination the reflex is found to be due to a growth situated back of the lens. It has a silvery or yellow, shining appearance, and small blood-vessels may be seen on it. As it increases the lens and iris are pushed forward, the tension of the eyeball becomes elevated (second, or glaucomatous, stage), and symptoms of irritation and inflammation appear. When the growth perforates the sclera (third stage) the tension falls, and for a few days the symptoms may seem to abate. Soon, however, the growth causes a noticeable tumor in the orbit, which increases more and more rapidly. Involvement of the brain through the optic nerve or of other organs (fourth stage) quickly occurs, and causes death. Sometimes the growth sets up an iridocyclitis that leads to diminished tension and shrinking of the eyeball (*cryptoglioma*), which, however, ends in the further extension of the tumor. In a large proportion of cases both eyes are affected.

Diagnosis.—The only affection liable to be confused with typical glioma of the retina is chronic purulent accumulation in the vitreous, or *pseudoglioma*. This gives rise to a

yellow reflex back of the lens, commonly exhibiting no vessels. Such an accumulation follows purulent retinitis or choroiditis, generally as a sequel to some acute febrile disease, as scarlet fever or cerebrospinal meningitis. Glioma gives no history of antecedent disease. In pseudoglioma the tension of the eyeball is almost always diminished. In glioma it is normal or elevated. Pseudoglioma remains stationary; glioma is progressive. In cryptoglioma diagnosis may, for a time, be impossible. But the eye, being blind, to treat it as the seat of glioma is proper in any doubtful case.

Treatment and Prognosis.—The treatment for glioma of the retina is **removal of the eyeball** at the earliest moment, with so much of the optic nerve as can be readily taken with it. If the growth has reached the third stage the removal of the whole contents of the orbit is necessary. Without complete extirpation of the tumor it always causes death. After early removal of the eye about one-third of the cases remain permanently free from the disease. But only the lapse of a sufficient period of time, at least three years, can give positive assurance that there will be no recurrence.

OPTIC NEURITIS, PAPILLITIS, PAPILLEDÈMA, OR CHOKED DISK is a swelling or inflammation of the ocular end of the optic nerve. It is important as a symptom of the diseases which cause it, and on account of the atrophy and impairment of vision which are liable to follow it.

Symptoms.—The essential symptoms, hyperemia and swelling, are only discoverable by the ophthalmoscope. Hyperemia at first causes the optic disk to appear redder, and more

uniform in color than normal. At the same time exudation causes blurring or complete obscuration of its outlines; so that the location of the disk may only be recognized by the convergence to it of the larger retinal vessels. As the inflammation advances, the swelling becomes greater; and measurement of their refraction with the ophthalmoscope shows that the vessels at the center of the disk are pushed forward into the vitreous. With the increased swelling the small vessels become separated by exudate, and the general color of the disk becomes more gray. The individual vessels, greatly enlarged and tortuous, appear and disappear in the swelling. The principal branches of the retinal arteries are small from compression at the point of entrance to the eye; and from compression at the point of exit the veins are swelled, dark, and tortuous. Hemorrhages occur mostly on or near the disk. Vision may not be noticeably impaired. It may remain practically normal, even with great swelling. When impairment of vision does occur, it is rather a sign of optic atrophy secondary to the neuritis, or of involvement of the visual centers or optic tract within the cranium. The course of the disease is essentially chronic, sometimes lasting for many months, or even several years, when caused by a slowly growing tumor. Ultimately, if the patient lives long enough, the swelling becomes paler and diminishes, and the process passes over into one of optic atrophy. Commonly both eyes are affected, although often one earlier or more severely than the other.

Monocular neuritis may occur from sinus disease or other local cause.

Diagnosis.—This rests on the ophthalmoscopic appearances above described. In a severe case these cannot be mistaken. But a commencing neuritis may easily be confused with hyperemia and slight haziness of the disk, often seen with eye-strain, and in rare cases protrusion and haziness exist as a congenital anomaly. In these doubtful cases repeated observations must be made. At this stage neuritis is progressive, the swelling and the alterations of the vessels increasing, while conditions with which it might be confused remain unchanged for a long period. *Subsiding neuritis*, which might also be overlooked, is likely to be attended by impairment of vision, especially by irregular contraction of the field of vision; and by opacity of the nerve-head hiding its deeper details, pigment-disturbances about the disk, and opacity of the walls of the retinal vessels or irregularities in the caliber of the same vessels.

Etiology and Pathology.—A mild form of optic neuritis may arise from eye-strain. Syphilis, influenza, lead poisoning, Bright's disease, and extension of inflammation from adjoining structures may cause it. But the larger number of cases are due to organic disease of the brain and its membranes, especially tumor, meningitis, and abscess.

[In a large series of cases Uhthoff found 71 per cent. caused by brain tumor, 12 per cent. by cerebral syphilis, and 3.6 per cent. by tuberculosis. He found that some involvement of the optic nerve was present in 79 per cent. of cases of tumor of the cerebrum; 88 per cent. of tumor of the cerebellum; 95 per cent. of tumors of the pons; 38 per cent. of tumors of the hypophysis, and 49 per cent. of tumors of the corpora quadrigemina. JACKSON].

The principal theories to account for papilledema are: 1. That the inflammation reaches the nerve-head by direct extension from within the cranium, either through the nerve-trunk or along its sheath. 2. That the inflammation is due to "choking of the disk" by intracranial pressure, transmitted by the veins or the lymph-spaces around the nerve to its point of entrance into the eyeball, where the sheath of the nerve is usually found dilated. 3. That the inflammation of the nerve-head arises through a nerve influence controlling its nutrition, and originating in afferent nerves distributed to the cerebral meninges. 4. That toxic substances make their way along the lymph-spaces surrounding the optic nerve from the cranial cavity to the nerve-head, where they excite inflammation. None of these theories seems consistent with all the facts, and it is probable that various influences contribute to the result. Relief of intracranial pressure is often followed by improvement in the neuritis, and Deyl suggests that the pressure may act by "choking" the central retinal artery and vein where they enter the optic nerve back of the eye.

Prognosis.—If the cause of the optic neuritis is one that can be removed, or the intracranial pressure can be permanently reduced, partial or complete recovery is likely to follow. Otherwise the neuritis passes into an optic atrophy, and blindness results. On this account, **trephining** to prevent blindness is justified. In a few cases the cerebral disease passes on to spontaneous recovery; but it may not do so until it has caused blindness, and the blindness may be permanent.

Treatment.—Besides the efficient treatment of its cause and especially the treatment for syphilis in all doubtful cases, the standard treatment for optic neuritis of intracranial origin is by **potassium iodide** in doses rapidly increased up to the limit of tolerance. Tapping the sheath of the optic nerve has been tried with the idea of relieving pressure, but it is of doubtful benefit. In these cases vision may be preserved by a timely operation for relief of intracranial pressure. Even if the cerebral disease be incurable and progressive, the preservation of vision to the end of life is a result that justifies operation.

RETROBULBAR OPTIC NEURITIS is marked by pain in the orbit and soreness or tenderness on moving the eye or pressing it backward. Vision is impaired in some part of the field of the affected eye, and it may be entirely lost or reduced to mere light perception in a few days or hours. Commonly the impairment is greatest at the center of the field. At first the disk may appear normal, or slightly swelled and hazy. Later it may show signs of atrophy. Recovery usually occurs, and vision may be completely restored. The causes are disease of the accessory sinuses of the nose, syphilis, acute fevers, and alcoholic or other poisoning. (See TOXIC AMBLYOPIA.) It may attend degenerative disease of the brain and spinal cord. It is to be treated through its cause, and by **local blood-letting, potassium iodide**, and, later, **strychnine**.

OPTIC ATROPHY.—Atrophy of the optic nerve consists essentially in atrophy of some or all of its nerve-fibers. It is always attended by impairment of vision, and is a common

cause of permanent blindness. It is also important as a sign of disease in the central nervous system.

Symptoms.—The impairment of vision generally affects central vision, and always includes some limitation of the visual field. It is at first progressive. The fields for colors are usually contracted earlier and to a greater extent than the field for form; and they may be obliterated, producing acquired color-blindness. When the blindness is complete, especially if it has come on rapidly, the pupils may be widely dilated. More commonly the pupils are not greatly enlarged. With the ophthalmoscope the optic disk is found less vascular than normal. It may be a dead white, or gray, bluish, or greenish hue. It presents few small vessels. The large branches of the retinal vessels may be of normal size, or they may be greatly contracted.

Etiology and Varieties.—Atrophy, not due to preceding disease of the optic nerve or retina, or to injury, or to pressure on the nerve or chiasm, is called *primary atrophy*. It may be congenital or hereditary or may follow acute disease or syphilis. It sometimes accompanies or precedes spinal sclerosis, or is caused by poisoning by lead, alcohol, etc. Atrophy following injury to, or pressure upon, the optic nerve is called *secondary*. *Consecutive atrophy* is atrophy following disease of the retina or choroid, as embolism of the central retinal artery or syphilitic chorioretinitis. Its causes are those of the conditions it follows. *Postneuritic atrophy* follows optic neuritis.

Diagnosis.—The ophthalmoscopic picture of advanced atrophy is usually quite striking. But commencing atro-

phy cannot be certainly recognized with the ophthalmoscope; and even the appearance of pronounced atrophy may be simulated in disease, like quinine blindness, or ischemia of the retina from severe hemorrhage, which admits of partial or complete recovery. The diagnosis is most safely based on narrowing of the field of vision, particularly for colors, with ophthalmoscopic appearances that point toward atrophy.

In primary atrophy the disk is usually gray and its details, with the lamina cribrosa, very distinct. The retinal vessels are not greatly narrowed. The field of vision is contracted regularly. In secondary atrophy the disk is more likely to be white. The retinal vessels may or may not be contracted. In consecutive atrophy the nerve-head is usually opaque, the neighboring choroid disturbed, and the retinal vessels somewhat contracted and often irregular in caliber. The visual field is irregularly contracted. After chorioretinal disease the disk shows dirty-yellowish color, and the lamina is hidden.

Prognosis.—Primary atrophy generally goes on to blindness. The prognosis for secondary and consecutive atrophies depends on early treatment and the possibility of controlling the cause.

Treatment and Prognosis.—The most effective measures are those directed to the causes of the atrophy, and they must be as varied as those causes. In addition, **mercury** and **potassium iodide** may be tried in the early stages, even in cases not of syphilitic origin. Later, **strychnine** should be tried in doses rising gradually to the physiological limit. This is sometimes as high as $\frac{1}{5}$ grain

(0.013 Gm.) three times daily by the mouth, or once daily hypodermically. General measures, including **change of occupation** and **climate**, may be beneficial. **Inhalations of amyl nitrite** and applications of **galvanic electricity** have been tried with reported benefit in some cases.

TUMORS OF THE OPTIC NERVE cause protrusion of the eye and loss of sight. They begin in childhood and develop slowly, without pain or much interference with the movements of the eyeball. They are usually myxomas or fibromas, which do not recur after removal.

EDWARD JACKSON,
Denver.

ORBIT, DISEASES OF.—CONGENITAL MALFORMATIONS.—

Meningocele—a protrusion of the brain-meninges into the orbit through a lack of development of the wall of the latter—is distinguished from other tumors of the part by presenting an elastic rounded swelling, which pulsates with the heart, and can be reduced by steady pressure until the defect in the orbital walls is revealed.

Anophthalmos, or congenital absence of the eyeball, is a rare condition; and in most cases there is found on dissection a small button of tissue representing the globe, which is often attached to a thin-walled cyst that distends the lower lid. The lids and orbits are commonly smaller than normal.

Microphthalmos, or congenital smallness of the eye, varies from cases that present only high hyperopia to those approaching anophthalmos. In the higher degrees the eyes are always quite defective. Both eyes are commonly affected.

Cryptophthalmos is the condition in which the eyeball, usually small and undeveloped, is buried in the tissues of the orbit, and can only be exposed by operation. There may be defective development or absence of the conjunctival sac and palpebral fissure.

Report of a case where both mother and daughter were thus affected bilaterally. The upper and lower lids were quite continuous. A few cilia were present, but no conjunctival sac. Operation revealed an undeveloped eyeball. Coover (*Ophthalmoscope*, vol. viii, p. 259).

DISPLACEMENTS OF THE EYEBALL.—**Enophthalmos**, or sinking of the eyeball within the orbit, is noticed after exhausting disease, in paralysis of the sympathetic nerve; neurotic facial atrophy, occurring periodically with neuralgia of the fifth nerve; and after traumatism. In the latter case it may be due to fracture of the walls of the orbit or to the influence of cicatricial bands, or absorption of orbital fat.

Exophthalmos, or undue protrusion of the eyeball, may arise from many conditions. It is the most striking symptom of exophthalmic goiter (see GRAVES'S DISEASE, volume v), and may be produced by emphysema of the orbit after fracture of the bones, including the air-passages. It is also caused by hemorrhage into the orbit or inflammation, disease of the orbital walls, new growths, or by paralysis of the ocular muscles, especially those supplied by the oculomotor nerve. Temporary exophthalmos may be produced in some persons by stooping and holding the head low.

PULSATING EXOPHTHALMOS.

This condition is attended with a distinct bruit heard over the

temple and neighboring parts and audible to the patient, is most frequently caused by a rupture of the carotid artery into the cavernous sinus. This may occur spontaneously; or from crushing injuries to the head. Pulsating exophthalmos has sometimes ended in spontaneous recovery. In other cases no lesion was revealed by post-mortem dissection. In a few cases it has been due to aneurism of the ophthalmic artery.

TREATMENT.—Pressure on the carotids, either intermittent, which may be made by the patient himself, or continuous, should be tried. When pressure fails, ligation of the orbital veins should be resorted to. These are usually distended, and may be reached through an incision or incisions near the margin of the orbit. Ligation of one or both carotids has been resorted to for this condition. But de Schweinitz and Holloway found that among reported cases there had been improvement in 65 per cent., failure in 25 per cent., and death in 10 per cent. The results of ligation of the veins have almost always been good.

A boy of 11 struck on the head noticed a buzzing sound followed in a few days by protrusion of the eyeball. After the condition had lasted three months an incision two inches long was made in the eyebrow. Superficial and angular veins were tied, and the superior ophthalmic as far back in the orbit as possible. The bruit and pulsation stopped instantly, and the eye gradually returned to normal position. F. C. Buchtel (*Ophthal. Record*, v. xxii, p. 75).

ORBITAL CELLULITIS.

General inflammation of the extraocular contents of the orbit arises

from traumatism, cold, erysipelas, other specific fevers, metastasis in septicemia, thrombosis of the cavernous sinus, or extension of inflammation from the eyeball, or from the walls of the orbit, or the neighboring cavities.

SYMPTOMS.—There is pain in the orbit, and often severe general headache, lessened mobility of the eyeball, protrusion of the eye, and swelling of the orbital tissues and lids. The vision is impaired and diplopia may be noticed. The invasion may be marked by a severe chill, and considerable fever may attend the disease. The eyeball is liable to become involved in the inflammation; and, even if this does not occur, optic neuritis and atrophy are apt to result. There is serious danger of extension to the meninges of the brain, causing death. In a few cases the symptoms are mild and spontaneous recovery occurs in a few days.

TREATMENT.—On the appearance of the earliest symptoms free local bleeding by leeching, or the artificial leech, should be resorted to, and calomel given and followed by a saline purgative. Hot fomentations should be applied, and frequently renewed to keep them as hot as can be borne. Any localized accumulation of pus should be promptly and freely evacuated. Even when no pus has accumulated, it is well to make incisions with a straight bistoury, from the retrotarsal folds of the conjunctiva, parallel with the orbital walls and as near them as possible, to the depth of an inch or more. When swelling of the lids interferes with the making of such incisions from the conjunctival sac, they may be made through the lids, near the orbital



Pulsating Exophthalmos and Glaucoma of the Left Eye.

margin. In any case they should be so placed as to avoid injury to the ocular muscles if possible. If the eyeball has been the starting point of the orbital inflammation, and is so damaged as to preclude vision, it should be promptly enucleated. The general treatment should often include tincture of **iron, quinine, and good feeding.**

Tenonitis, or inflammation of the oculo-orbital fascia, presents many of the symptoms of orbital cellulitis, but in less severe form. The immobility of the eye and pain on movement are relatively great, but the swelling is less general and severe. It arises from traumatism, as from a squint operation, or is of a rheumatic or gouty character.

TREATMENT includes **hot applications**, and **free exit** for any pus that may be formed. Sometimes **local bleeding** is important. The rheumatic and gouty cases yield to **salicylates** or **iodides**; pain may require the use of **anodynes**.

ORBITAL TUMORS.

These cause displacement of the eyeball, dependent on the location and the size of the tumor. Sometimes there is limitation of the movements of the eyeball or double vision. But with slowly growing tumors there may be great displacement of the eyeball, without diplopia or destruction of vision. Pain usually appears late in the progress of the growth.

VARIETIES.—**Tumors of the optic nerve** cause early blindness and optic atrophy; the displacement is usually directly forward or a little outward, and ocular movements remain good. Tumor of the optic nerve is usually fibroma or myxoma, showing little or no tendency to recur after

removal. Removal may require **enucleation of the eye**, or it may sometimes be accomplished without enucleation of the eyeball, by **osteoplastic resection of the outer wall of the orbit** (Koenlein's operation).

Dermoid Cyst.—This variety of growth appears as a rounded, slowly growing tumor, which is seen most frequently at the upper inner angle



Tumor of the orbit. (Vance.)

of the orbit; but it may be situated at the outer angle or the upper or lower margin. It sometimes extends very deeply, to the apex of the orbit or even into the cranial cavity.

Cysticercus and **echinococcic cysts** also occur in the orbit, but are extremely rare in this country.

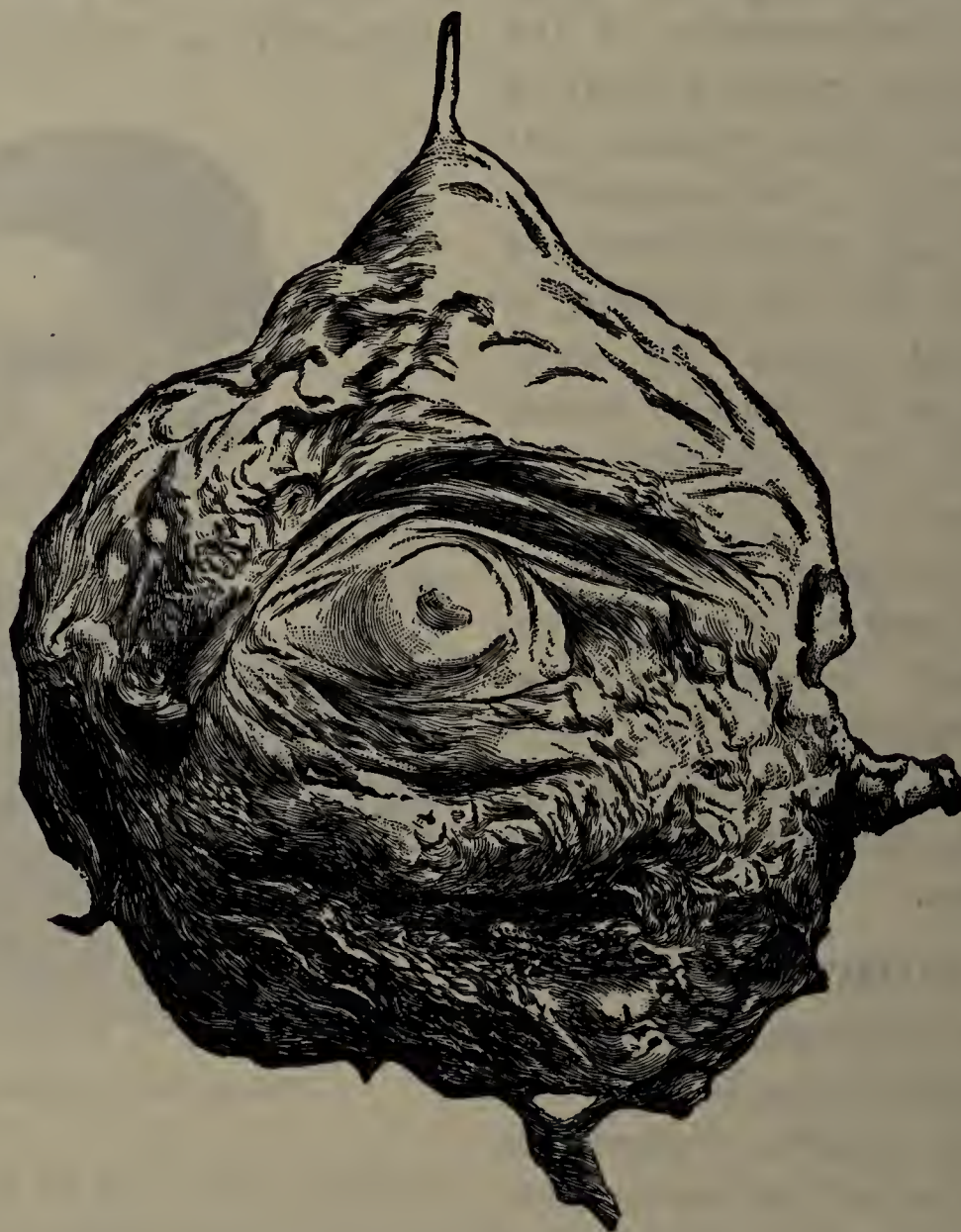
Angiomata, both simple and cavernous, occur in the orbit. They are compressible and commonly involve the lids. They increase in size with crying, or on holding the head down. They rarely exhibit pulsation; and the pulsation is never so marked

as in meningocele or pulsating exophthalmos.

Sarcomata.—These are the important malignant tumors of the orbit. They may be so vascular as to pulsate and be compressible; or they may be hard and fibrous, growing very slowly, and causing great dis-

part of the sac left behind should be cleansed, and tincture of iodine or crystals of silver nitrate placed in it to secure its obliteration. Where possible, benign tumors, even those of the optic nerve, should be removed without sacrificing the eyeball.

For malignant tumors the only



Tumor of the orbit. (Vance.)

placement of the eyeball, without entire destruction of vision.

Carcinoma of the orbit is always secondary to similar disease of the lachrymal gland, lids, conjunctiva, eyeball, or adjoining cavities, or more distant organs.

TREATMENT.—Non-malignant tumors should be **excised**. If a dermoid cyst be so deep that its complete removal by dissection would be extremely difficult or impossible, the

hope for cure is by **complete removal**. In rare cases, where the eye retains useful sight, removal of the evident new growth must be depended on. But the prospect of future immunity is decidedly improved by the removal of the whole contents of the orbit. Sarcomas of the spindle-cell variety may not return. Other varieties are more likely to recur, and it is doubtful if removal often prolongs life. It is, however, fully justified for the



Tumor of the Orbit.

purpose of relieving pain and rendering the patient's condition temporarily more bearable.

MISCELLANEOUS ORBITAL DISEASES.—Diseases originating in the orbital walls and neighboring cavities include a large proportion of the cases of orbital disease. The majority of malignant tumors grow into the orbit from adjoining cavities. **Mucocele** or **empyema of the frontal, ethmoidal, or maxillary sinus** makes its way into the orbit, sometimes through an opening caused by absorption of the bony wall, sometimes pushing a bony shell before it. The most important **treatment** is that **directed against the original disease**. This, with **free drainage**, will generally secure the healing of the lesions in the orbit.

Periostitis and caries of the orbital walls cause orbital swellings, inflammation, abscess, and discharging sinuses. They must be treated as such lesions elsewhere, with especial care to keep up **free drainage**, and not to attempt the **removal of dead bone**, except after very careful study of the case, and through a free opening.

Osteoma of the orbit, or ivory exostosis, is a very hard, bony tumor, invading the orbit from the frontal or ethmoidal sinus, and sometimes also invading the cranial cavity. It appears at the upper inner angle, or the upper margin of the orbit, and grows very slowly, displacing the eyeball downward and usually outward, and for a long time continues painless. It should be **removed** as early as possible to forestall the danger of extension inward. There is little tendency to recurrence.

EDWARD JACKSON,
Denver.

ORCHITIC EXTRACT. See ANIMAL EXTRACTS.

ORCHITIS. See PENIS AND TESTICLES, DISEASES OF.

OREXIN.—Orexin is chemically known as phenyldihydroquinazoline tannate— $C_{14}H_{12}N_2(C_{14}H_{10}O_9)$. It occurs as a yellowish-white, odorless, and practically tasteless powder, insoluble in water, and slightly soluble in alcohol, and soluble in dilute hydrochloric acid. It is incompatible with preparations of iron.

THERAPEUTIC USES.—It is chiefly used to improve the appetite and as an antiemetic, in doses of from 8 to 12 grains (0.5 to 0.8 Gm.), given in wafers, powder or in tablets, with a half-glass of water. It is indicated in **anorexia**, in the absence of gastric disease, to restore the appetite in **phthisis, chlorosis, cardiac disease**, and **after surgical operations**, etc. Its antiemetic properties are utilized in the treatment of the **vomiting of pregnancy, seasickness** and the **vomiting following narcosis**. This remedy is contraindicated when hyperacidity of the stomach or gastric ulcer is present. W.

ORGANIC EXTRACTS. See ANIMAL EXTRACTS.

ORIENTAL SORE.—This disease, also known as Delhi boil, Aleppo boil, Biskra boil, Bagdad boil, dermal Leishmaniasis, etc., is a specific, circumscribed, ulcerative affection of the skin caused by *Leishmania tropica* Wright. Many different diseases have been described under that name, among them the so-called Nile boil (of pyogenic origin), and the Bucharest boil, which have no connection with oriental sore.

SYMPTOMS.—After an incubation period varying from a few days to several weeks or months, marked by irregular attacks of fever, one or more itching spots may be seen on the skin of an uncovered part of the body (feet, legs, hands, arms, face), having the appearance of a mosquito-bite. These spots become red, shotty, and elevated, and are surrounded by an area of inflammation which later becomes indurated. These hard papules slowly enlarge

until they are the size of a pea or bean and their surface, previously smooth and shiny, becomes covered with small, thin scales. Ulceration of this nodule, beginning after not more than three or four months, is at first superficial, with a yellowish secretion which, however, soon dries into an adherent, hard, darkish scab, beneath which the ulceration slowly progresses, the nodule becoming disintegrated. The tissues about the ulcer may become the seat of edema. The ulcer is usually indolent, and but slightly painful. The neighboring lymphatic glands do not become enlarged unless by secondary pyogenic infection. The blood-picture shows an increase of mononuclears, while the leucocyte count may be normal or may show leucopenia; the coagulability of the blood is increased. The ulcers begin to heal by granulation after four to twelve months, leaving a whitish or pinkish scar, which is often depressed, and which may again break down.

The disease is not only spread by direct infection from man to man, but is also autoinoculable. It is conveyed by absorption of the virus through some breach in the skin surface (cut, scratch, wound, ulcer). Insects, especially flies, are probable carriers of the disease.

DIAGNOSIS.—The diagnosis is made from the fact that the patient comes from, or is living in, an infected area, from the natural course of the disease, from the non-enlargement of the contiguous lymphatic glands, and, finally, by the discovery in scrapings from the edges and floor of the ulcer of *Leishmania tropica*. Leishman's, Giemsa's, or any other Romanowsky stain will facilitate the discovery of the parasite.

PROGNOSIS.—So far as life is concerned the prognosis is good, although death may, though rarely, occur from phagedena, and from secondary septicemia and pyemia.

TREATMENT.—This is, as a rule, unsatisfactory and an expectant treatment is advised. After removing the scabs with boric acid fomentations, the ulcers are disinfected once or twice daily with a 1:1000 solution of **mercury bichloride**, or 2 per cent. **phenol**, and then dressed with an antiseptic ointment of **betanaphthol**,

iodoform, **euophen**, **boric acid**, or **balsam of Peru**, or dusted with an antiseptic powder (**boric acid**, **orthoform**, **xeroform**, etc.). Castellani had good results from the use of a 5 per cent. solution of **protargol**, followed by a 20 per cent. protargol ointment, but cautions against its use in Europeans when the face is affected, as it discolors the skin. S.

ORTHOFORM.—Orthoform is the methyl ester of para-aminometaoxybenzoic acid. It occurs as a fine, white, odorless, crystalline powder, neutral in reaction, slightly soluble in water, and easily dissolved in glycerin, in 5 or 6 parts of alcohol, in 50 parts of ether, or in water acidulated with hydrochloric, nitric, or acetic acid. It is feebly antiseptic. It possesses an anesthetic and analgesic action, like cocaine, but does not penetrate the tissues on account of its insolubility, and persists longer.

Orthoform hydrochloride occurs as a white, crystalline powder having an acid reaction, and soluble in 10 parts of water.

PREPARATIONS AND DOSES.—Orthoform is not official, but may be used in the following forms:—

1. The crude powder, either alone or mixed with equal parts of lycopodium, or milk-sugar, which should be accurately insufflated upon the required area, since orthoform takes effect only on contact and does not extend beyond. Internally it is given in doses of from 8 to 15 grains (0.5 to 1 Gm.) in emulsion.

2. Pastilles: Orthoform, 3 to 5 grains (0.2 to 0.3 Gm.); solution of cochineal, q. s.; saccharin, $\frac{1}{4}$ grain (0.015 Gm.); glycogelatin, q. s. These pastilles are useful in **oral**, **tonsillar**, and **postpharyngeal** affections.

3. Orthoform collodion: A saturated solution of orthoform in collodion. This is useful in **ulcers** exposed to much friction; but, as it causes acute smarting, it is advisable to anesthetize the ulcer first, either with cocaine or with orthoform in powder.

4. Spray: Orthoform, 5 grains (0.3 Gm.); alcohol and water, of each, 50 minims (3.3 c.c.). This is used in spray and is, perhaps, the best form for treating **nasal and laryngeal ulcerations**. The alco-

hol evaporates quickly after contact with the parts, leaving the precipitated powder evenly distributed over the affected area.

5. Ointment (10 to 20 per cent.), with lanolin.

6. Aqueous solution (10 per cent.) of the hydrochloride as a paint.

PHYSIOLOGICAL ACTION.—Orthoform is said by Kallenberger to be free from any toxic property, but this has not been found to be strictly true. When it comes in contact with sensory nerve-filaments it has a powerful anesthetic effect, which persists in some instances for three or four days; on account of this property it is an excellent dressing for **burns** or **painful ulcers**. An important property is its inhibiting effect upon secretion; in case of **carcinomatous ulcers** or of **transplantation wounds** the dressings remain so dry that they seldom require renewal.

Experiments by Soulier and Guimard showed that in the dog a dose, by mouth, of orthoform which exceeds 15 grains (1 Gm.) per kilo (2.2 pounds) of body weight is to be considered toxic. But warm, 1 per cent. solutions of orthoform, injected into the peritoneal cavity, produce toxic effects in the dose of $3\frac{3}{4}$ grains (0.25 Gm.) per kilo (2.2 pounds) of weight. The substance may, indeed, cause death in six minutes if it reach the dose of $7\frac{1}{2}$ grains (0.5 Gm.) per kilo (2.2 pounds).

The action of orthoform, after injection, is that of a powerful cerebrospinal nerve-depressant. Its local action, on the other hand, requires direct contact with the nerve-endings. Soulier and Guimard consider that orthoform is an *analgesic*, in the true sense of the word, rather than an anesthetic.

When orthoform is taken internally it is absorbed from the intestinal canal, and is eliminated somewhat changed by the kidneys. The urine does not readily undergo putrefaction during its administration.

POISONING BY ORTHOFORM.—Although orthoform is considered non-toxic it sometimes exerts an irritating effect upon the skin. It may cause erythema, alone or complicated with vesicles or pustules, and gangrenous eruptions. The former may appear even when the orthoform is applied upon healthy skin

without breach of surface. The gangrenous eruptions follow the treatment of varicose ulcers with orthoform.

Brocq reports a case in which the application of an ointment (1 to 40) to the face induced great swelling and marked redness, lasting nearly three weeks. In another patient use of the powder on a fissure of the vulva caused intense tumefaction, and nodular swellings in various parts of the body.

Asam observed a peculiar necrotic process appearing in the course of three to fourteen days after the application of orthoform to tumors, ulcerations, wounds, etc., and retrogressing when the orthoform was stopped. The first inflammatory stage of the process produced metastases in 6 cases, by reflect action or by the circulation, terminating in the necrotic stage. In the 9 cases reported orthoform at first produced its usual favorable effect. In numerous other cases in which it was used both internally and externally there were no unpleasant results from its use.

THERAPEUTICS.—Orthoform is chiefly used in **painful ulcerations of the upper air-passages**. It occasionally produces a slight burning for a few minutes after its application. It may replace cocaine when **prolonged anesthesia of ulcerated surfaces** is desired, cocaine being reserved to produce temporary anesthesia of an intact mucous membrane.

Orthoform gave Lichtwitz good results in **hay fever**, the powder being insufflated into the nasal cavities. In **faucial troubles** where there is no ulceration, but where the epithelial layer of mucous membrane has been denuded, the application of orthoform relieves the pain and reduces the inflammation. After **removal of the faucial tonsils**, if orthoform is applied to the cut surfaces the patients can eat solid food without pain, and the parts heal quickly. There is no pain after **removal of an elongated uvula** if orthoform is applied.

An emulsion of orthoform, 25 parts, and olive oil, 100 parts, has been used for **laryngeal** application chiefly in cases of **tuberculosis**. A distinct diminution in the amount of secretion in cases of ulceration is noted, but otherwise it does not appear to have any local therapeutic value. Patients do not dread the **lactic acid treat-**

ment if orthoform emulsion is used regularly.

Orthoform and arsenic (equal parts) are used to make a painless paste to be applied as an escharotic in **epithelial cancer** and small **superficial growths** (1 part of the mixture to 45-70 parts of alcohol and water).

Orthoform is used as an application to **burns and painful sores**, applied in powder or ointment (10 to 20 per cent.).

Cracked nipples dressed with an alcoholic solution of orthoform brings about complete anesthesia during suckling and keeps the cracks aseptic. The infant is put to the breast a quarter of an hour afterward and sucks eagerly, as orthoform has neither taste nor smell. The anesthesia is absolute and persists for a considerable time.

Orthoform is the sovereign agent for the pains occurring **after the extraction of teeth with peridentitis**. It may be applied on a moist piece of cotton.

After **operations about the rectum**, about the **urethra**, and **sexual organs**, the intolerable pains, smarting, burning, or itching are relieved by the use of orthoform, as a powder, in the first dressing, its action lasting about twelve to twenty-four hours. Orthoform after **operations for the removal of hemorrhoids** has been used with the most satisfactory results.

Orthoform may be applied without danger to **ulcerations of the mouth, pharynx, and larynx**. It is also particularly useful as an analgesic in **dysphagia** due to **cancerous ulceration of the epiglottis or esophagus**. Two and a half grains (0.15 Gm.) in cachet will ease the pharyngeal pains of **gastric ulcer** in five minutes.

Local Anesthesia.—Hirschbruck, to obtain local anesthesia, injects a 2 per cent. solution of cocaine ($\frac{1}{30}$ grain—0.002 Gm.—of the salt) and then injects 15 minims (1 c.c.) of distilled water containing 3 per cent. of orthoform ($\frac{1}{2}$ grain—0.03 Gm.) in suspension, the syringe being constantly shaken when administering the latter. This process appears to be quite free from danger. Anesthesia is induced in from five to ten minutes.

By mixing 5 to 10 per cent. of orthoform with a 10 per cent. solution of **mercury salicylate**, the pain accompanying intra-

muscular injections for syphilis is prevented or relieved.

Orthoform may be combined with Schleich's method in following manner: An injection is first made after Schleich's method, which permits the painless incision of the tissues. The anesthesia is then completed and rendered more profound and durable by powdering the wound with orthoform.

In **carious teeth** with exposed nerve-endings a piece of cotton dipped into a saturated alcoholic solution of orthoform, packed not too tightly, will arrest the toothache in three or four minutes, and will hold its anesthetic effect for several days if packing is not removed.

Orthoform may be taken internally in doses of 8 to 15 grains (0.5 to 1.0 Gm.) as an internal anodyne.

It may be given in doses of from 15 to 20 grains (1.0 to 1.3 Gm.) per day, and it is said to relieve pain in **cystitis** and **gonorrhea**.

In affections of the stomach about 3 knifepointfuls of orthoform should be given in a glass of water. This is to be taken at a draught and the patient should then lie in various positions successively, to insure contact of the mixture with the gastric wall at all points, unless any particular portion of the wall is the seat of pain, in which case the patient should lie in such a position as to bring about the prolonged application of the drug to the affected area. In **ulcer of the stomach** and in **carcinoma** (at the stage of ulceration) the analgesic effect is well marked. It is best administered on an empty stomach, and is especially efficacious after the organ has been washed out. W.

ORTHOPEDIC SURGERY.—
DEFINITION.—Orthopedics is that branch of surgery which relates to the prevention and correction of deformities. Although it is difficult to draw a sharp line between cases that enter into the field of orthopedic surgery and those that do not, it is generally conceded that true orthopedic cases are usually chronic rather than acute, entail marked disability and

require prolonged treatment, often with mechanical appliances.

CLUB-FOOT.

GENERAL CONSIDERATIONS AND VARIETIES.—Club-foot is the name applied to a condition of the foot in which it is more or less deformed and displaced from its normal position. The displacement of the foot is in the direction of a normal movement; thus, it may be inward, when it is called *pes varus*; outward, when it is called *pes valgus*; flexed anteriorly, constituting *pes calcaneus*; and extended, causing walking on the toes, when it is called *pes equinus*; a hollowing of the arch of the foot is known as *pes cavus*. The distortion may be a compound instead of a simple one, producing an *equinovarus* or *equinovalgus*. Often the affection is congenital, but not rarely it is acquired; in such cases paralysis usually plays an important part.

The writer recognizes three etiological factors: Heredity in 5 per cent.; early intra-uterine causes, depending on faulty nutrition from diseased chorionic villi in 10 per cent.; while mechanical causes, operating later in intra-uterine life, account for most of the remainder. In this last class causal factors of importance are poor hygiene in pregnancy and work during pregnancy. Ehrenfried (Jour. Amer. Med. Assoc., Nov. 30, 1912).

The most common form is equinovarus, in which the foot is raised at the heel and the sole turned inward. Ordinarily the diagnosis is easy, but a wrong course is not infrequently pursued, hardly on account of the difficulty in recognizing the condition, but rather because the parents and even occasionally the physician do not appreciate the necessity of in-



Equinus.



Calcaneus.



Varus.



Valgus.

Varieties of simple club-foot. (McCurdy.)



Equinovarus.



Equinovalgus.



Calcaneovarus.



Calcaneovalgus.

Varieties of compound club-foot. (McCurdy.)

stituting treatment at once. In congenital cases treatment can be carried on with advantage almost from the moment of birth, yet it is not seldom that the importance of undertaking treatment is only appreciated when the child attempts to walk, eight months to a year and even later. The difference between the acquired and congenital forms should be carefully established, as it influences both prognosis and treatment. In the congenital form, the muscles of the lengthened tendons are not paralyzed, but merely disabled by their abnormal position. When, therefore, the faulty position is corrected, the muscles will resume their functions, and the prognosis as regards an ultimate good result, and even complete cure, is excellent.

Again, in the acquired form paralysis of one set of muscles is usually more or less complete, and as this is often permanent it is obvious that in many cases a cure cannot be expected, and the best that can be done is to improve the function and appearance of the part. Operative measures are to be undertaken only with the greatest care. It is evident that if tenotomy is performed on the contracted muscles the limb is left helpless, as both sets of muscles are disabled.

PES EQUINOVARUS.—In simple varus the foot is turned inward. The cases, however, usually have the heel more or less drawn up, and the affection is then designated equinovarus. The affection is usually congenital, and both sides are generally affected. The acquired form results from disease of the bones or else paralysis—sometimes cerebral, but oftener spinal. In the congenital form treatment should be instituted as soon as

the affection is discovered. The worst cases met with are neglected cases or those in which treatment has been inefficient. It is natural for the feet of an infant to turn inward rather than outward; therefore an outward deformity is more apt to attract attention than is the affection we are now considering. The fact that the feet are turned in a little more than is usual or that they are kept more persistently inward than they ought to is a circumstance apt to be overlooked. The child does not attempt walking for several months and therefore careless parents allow the deformity to continue until it interferes with the child's efforts to walk. The infant's foot is largely cartilaginous, and on that account is more readily molded into proper form than when the child is older. It is on this account that treatment should be commenced as soon after birth as possible. This softness of the infant's foot also prohibits the use of severe measures; its shapelessness also renders it impossible to apply apparatus in the form of shoes, and even other appliances are only retained for any length of time with difficulty.

Treatment.—In the treatment of congenital equinovarus in infants of from one to three months of age the main reliance must be placed on **manipulations** or **stretchings**. This stretching consists in endeavoring to straighten and replace the foot in its normal position by manual force. It is to be done by the mother or nurse three times daily. The following is the method of performing it: The leg is grasped, close down to the ankle-joint, by the left hand; the anterior portion of the foot is then twisted or rotated outward with the

right hand, so as first to overcome the condition of varus present. This having been done, the foot is flexed on the leg so as to stretch the tendo Achillis. In other words, the foot is first twisted outward until the ball of the big toe is in line with the internal malleolus and side of the leg and then flexed on the leg to bring down the heel.

One of the writers noted in several hundred treated cases of congenital clubfoot that practically none of the severe cases showed dorsal flexion to a right angle without breaking the mediotarsal joint. A study of these cases by the X-ray showed that the only reliable test for the correction of the equinus if there is a rounded sole is a röntgenogram. Many cases which have shown apparent overcorrection, when studied by X-ray show a break at the mediotarsal joint, with the malposition of the os calcis not rectified. These gradually become worse and constitute "relapsed club-feet." Zadek and Barnett (Jour. Amer. Med. Assoc., Sept. 29, 1917).

This is to be done several times at one sitting morning, noon, and night. In very young infants this is to be the only treatment instituted. If the infant is a little older and robust, and the foot well developed, the stretching can be done morning and night, and on its completion a **bandage** may be applied while the foot is held straight. Flannel is best: from the toes to the knee. This has a distinct influence in correcting the deformity. If the child is older—say about the age of three months and even, in some cases, earlier—the bandaged feet may be placed in ordinary **right-angled splints** made of tin or felt. These should be padded with a little cotton and the bandaged feet placed in them. The heel should be brought down as well as possible by pressing the sole of the

foot down on the splint and holding it there with one hand while the bandage is applied with the other. It facilitates matters to have one person hold the foot in position in the splint while another applies the bandage. As the child increases in age another method is useful. It consists in first bandaging the foot and leg in several thicknesses of flannel bandage (leaving the toes exposed for observation) and then applying over all a **plaster-of-Paris bandage**. The foot is to be held in the corrected position until the plaster sets. Too much should not be attempted at the first trials and one should see the child soon after the application of the bandage to see that the latter is not too tight. The toes constitute a fair guide: if these are pinkish and not blue and swelled one may be assured that the circulation is satisfactory. This bandage should not be left on longer than a week. On its removal the foot is to be bathed with whisky and alum or alcohol. Repeated applications of the plaster-of-Paris bandage will in a short time cause such improvement that if the child's foot is sufficiently developed some sort of **permanent appliance** may be tried. The most common appliance is a shoe fastened to side-irons, which have joints at the ankle. An elastic band goes from the foot to one of the side-irons and tends to flex the foot on the leg and thus bring the heel down. The shoe is laced down to the toes and a strap passes over the instep to hold the foot in place while the shoe is being laced. This **brace** should be removed daily, the feet bathed, and the brace reapplied and worn at night as well as during the day. In severe cases **better** command of the foot will be ob-

tained by continuing the side-irons above the knee, a joint being inserted at the latter point.

Another form of **splint**, instead of the ordinary right-angled gutter-splint above mentioned, consists of a foot-piece cut in the shape of the foot and made out of quarter-inch-thick board. To this is fastened an iron upright which goes up alongside the leg, and encircles it half-way around just below the knee. The foot is firmly strapped to the foot-piece by means of adhesive plaster and covered with a bandage, which is carried up to the knee. The iron upright is then bent backward and its upper part hooked around the back of the leg, and the whole covered with the remaining portion of the bandage. This is to be changed every few days, and if the adhesive plaster causes soreness of the foot the latter is to be first covered with a bandage and then strapped with adhesive plaster to the foot-piece. Recently I have modified this splint by inserting a joint at the ankle and fastening the upright to the foot-board by means of a hinge-joint. The iron goes up the inner side of the leg and a light rubber tube passes from the outer side of the iron upright at the knee to the outer side of the foot-board well forward. By its constant traction the elastic tends to correct the deformity.

The question of **tenotomy** will arise. In very young infants it is better not to resort to tenotomy at once. In many cases after a few weeks' treatment it will be found unnecessary. In some infants the deformity is so firm and resistant as to make it practically impossible to keep the braces or splints on or to bring down the heel. In these cases no hesitation

should be felt in resorting to tenotomy. Usually a tenotomy of the tendo Achillis will be sufficient. In older and more rebellious cases tenotomy of the anterior and posterior tibials in addition to the tendo Achillis will be required. Also at times the contracted plantar fascia should be divided.

The writers applied **Finck's method** in the treatment of talipes in 30 cases and extol it as extremely effectual. The results were perfect in 50 per cent.; in 37 per cent. **simple tenotomy** was required besides, and in 12 per cent. **internal or posterior arthrotomy** proved necessary, but the second operation was much facilitated by the preceding treatment. Finck commences the correction of the talipes the very day of birth, keeping up the **massage** in a progressive and a continuous manner and **maintaining the correction** obtained by a **flannel bandage** wound over a hard sole with thick felt lining. The bandage is removed each time for the massage. By the age of 2 months the tissues are too firm to commence effectual massage. The best results were obtained by first correcting the adduction of the front part of the foot, correcting also to a slight extent the supination, but not acting on the equinus position. In the second sitting, next day, the supination and equinus position are combated, and so on until hypercorrection is realized so that the foot retains the normal position after the bandage has been removed. This result is generally obtained with twelve sittings or less. G. Nové-Josserand and A. Rendu (*Jour. Amer. Med. Assoc.*, from *Lyon Chir.*, Aug., 1912).

When the child attempts to walk, a **walking-shoe** should be ordered. This is similar to the night-shoe, except that it is made stronger and more suitable to stand the wear and tear of continued use.

As cases grow older so do the difficulties of treatment increase: The feet should be put up in **plaster of Paris** and held as nearly as possible in the corrected position until the plaster sets. After a few weeks' trial, if satisfactory progress is not made, **tenotomy** should be performed and the plaster reapplied until later on **walking-shoes** may be worn.

In resistant cases hand **stretching** is not efficient. In such the feet may be stretched or forced into shape by instrumental appliances such as the **Thomas wrench** or other **club-foot stretchers**.

In still more severe cases more radical procedures are sometimes demanded. Of these the **open section of the tissues** of the inner side and sole of the foot as advised by A. M. Phelps may be tried. The cases of excision of the astragalus alone for equinovarus which have come under my notice have not seemed to me to be satisfactory. In those cases in which it brought the foot into fairly good position less radical measures would probably have been sufficient, while in the bad cases the deformity persisted, even after the bone had been removed. This is only to be expected because in equinovarus both the inner and outer arches are disturbed, while removal of the astragalus simply affects the inner arch.

The important part played by the knee in the correction has been almost entirely overlooked. The deformity develops with the **knee flexed** to the utmost, and it should be flexed at a right angle in the **immobilization** by means of **adhesive bandages**. This has the great advantage that the sole can be held in proper position by **traction on the knee**. Treatment should commence the moment the child is first pre-

sented to the physician, even if it is only one day old. No anesthesia is required, merely a stout, twilled, cotton-flannel bandage about 4 or 5 cm. wide. Oettinger (Med. Klinik., Nov. 22, 1908).

In the most severe cases, those varying in age from 6 years to adult life, I have resorted to **wedge-shaped resection**. This is done by making an incision over the cuboid and anterior part of the calcaneum and then gouging out the bone clear across the tarsus. The parts removed consist of the anterior part of the calcaneum and astragalus and either the whole or part of the cuboid, scaphoid, and the three cuneiform bones.

In children who can rest and have ample care, the writer advises daily **manual correction** under the supervision of the physician. In the intervals the corrected position should be **maintained** by appropriate **apparatus**. Later, these measures proving insufficient, **tenotomy** and **forcible correction under chloroform** are to be added. With sufficient patience, excellent results may thus be obtained, even in severe cases. Savariaud (Presse méd., Sept. 7, 1912).

Immediately after birth place strip of **zinc oxide adhesive plaster** over sole and inner aspect of foot, **over-correct position** of latter, and draw plaster tightly along outer aspect of leg. Place second strip over sole just posterior to base of metatarsals, extending over inner aspect of foot and ending over joint of great toe. Draw firmly, apply to outer side of leg, one to two and a half inches above external malleolus, and wrap around leg in ascending spiral. Place further strips to cover and tighten the second tension strip, beginning on leg two inches above ankle and overlapping until instep is reached. Renew dressing after cleansing foot with ether and alcohol, ten days or two weeks later. Deformity will be corrected in six or eight weeks.

Leave foot with **stiff-ankle infant-shoe**, with one strip of adhesive on outer side of foot and leg. Allen (Amer. Jour. of Obstet., Oct., 1912).

TALIPES EQUINUS.—In talipes equinus the heel is elevated and the patient walks on his toes after the manner of a horse; hence the name. It is usually an acquired affection. In infantile paralysis the loss of power in the anterior muscles of the leg allows the unopposed muscles of the calf to draw the heel upward. For a certain length of time after paralysis has occurred the foot can be brought to its normal position, but, if no means are taken toward guarding against drawing up of the heel, the healthy muscles and tendo Achillis will permanently shorten and thus the deformity will be produced. It is a condition which commonly occurs as a sequence of injuries of the leg. In fractures, particularly if much violence has been done in the neighborhood of the ankle, and attention is not paid to the position of the foot, when the time comes for the patient to walk the foot will be found to be more or less firmly fixed in the position of equinus. Again, after injuries of the deep structures of the back of the leg the same condition is produced. Cicatrices will not infrequently draw the heel up.

Treatment.—The treatment in cases in which this deformity is liable to occur should be directed to preventing it. In cases of infantile paralysis patients with toe-drop are liable to suffer from contraction. In order to avoid this an efficient **brace** can be worn consisting of a sole-plate and two side-irons (or even one) with a joint at the ankle which prevents the foot being extended to more than a

right angle. It may be made to be worn inside the shoe or outside and fastened to the sole. In cases of injuries and fractures some **splint** or **appliance** should be used which prevents the heel from being drawn up. If the condition is already present when the patient is seen, if it is not too resistant, **massage** and **manual stretching** followed by the application of a **right-angled splint** will suffice to bring the foot to a normal position. This once accomplished, a **walking-brace** should be prescribed or a light firm **splint**—such as can be made of **leather** or **silicate of soda**—may be used to hold the foot at right angle. When the affection is of longer duration the **tendo Achillis** should be **divided** and the case treated as already detailed.

In old cases the **plantar fascia** will be found contracted as well, oftentimes, as the **tendons** of the **toes**. These should all be **divided**, the **toes** **flattened out**, the foot **unfolded**, and the **heel** **brought down**. In cases which have resulted from paralysis of the leg-muscles particular care should be taken not to unduly lengthen the **tendo Achillis**, or else control of the foot will be much lessened and walking will be made worse.

TALIPES CALCANEUS.—**Diagnosis.**—This deformity may be either congenital or acquired. The foot is drawn up toward the leg and the heel is down.

Treatment. — **Shortening** of the **tendo Achillis** may be performed in these cases. The tendon should be divided obliquely and the ends overlapped and fastened with a couple of fine-silk sutures—introduced back and forth, as in a mattress suture. The wound should be closed without

drainage and the foot placed in a **splint**. Division of tendon in these cases is not often required; all that is necessary is to apply some sort of **splint** or **brace** that will maintain the foot at a right angle. If the case is a walking one an **apparatus** with an **ankle stop-joint** that allows extension, but not flexion, will be required.

During the past year the writer has done the **Whitman operation** 20 times upon 18 patients, and the immediate results have been so gratifying that he indorses the procedure. Too few surgeons employ this method of radical relief. The operation, moreover, has a wider range of application than for calcaneus alone, and may be modified by various tendon transferences to meet special indications. In brief, the Whitman operation consists of: 1. The removal of the astragalus. 2. The freeing of the malleoli and the preparation of a new articulation. 3. The transplantation or resuture of the peronei tendons. 4. The backward displacement of the foot. 5. The fixation of the foot in equinus. In the after-treatment a fixation plaster is kept in position for about four weeks; then an ambulatory plaster is used for about five months. As to the results, cavus and lateral instability are corrected, the backward displacement checks dorsal flexion by direct contact and by change in leverage, and the power of the transplanted muscles is made more effective. This operation is the only effective procedure for an advanced deformity, and it is also indicated in early cases as a preventive of progressive deformity.

The typical or stereotyped operation is not always to be strictly adhered to, because indications vary, especially when the operation is performed to ameliorate conditions other than the one for which the operation was originally devised. J. P. Lord (Jour. Amer. Med. Assoc., Oct. 11, 1913).

The most important of all the forms of talipes is calcaneus, because paralysis of the calf-muscle disables both functions of the foot (to serve as a secure support and to balance and propel the body), and induces a deformity which progresses in spite of mechanical support. The **removal of the astragalus** is indicated as the essential preliminary to permanent relief. The laxity of tissue thus obtained enables us to displace the foot backward and to implant the malleoli on their basic structure, near the center. This equalizes the leverage and checks dorsal flexion by direct impact of the tibia on the scaphoid. Royal Whitman (Med. Record, Jan. 10, 1914).

Talipes equinus following a leg wound might have been prevented in 75 per cent. of soldiers, if early exercise of the ankle and re-education had been carried out. Even the pressure of the bedclothes may bring on the talipes, but the usual cause is using the leg too early, stepping on the toes to reduce the pain and thus establishing the deformity. Hardouin (Revue de Chirurgie, Jan., 1916).

PES CAVUS.—Diagnosis and Treatment.—In certain cases of paralysis the heel assumes the position of calcaneus, as above described, while in addition the anterior leg-muscles are paralyzed, thus allowing the toes to drop. This condition allows the heels and toes to come closer together and consequently relaxes the normal tension on the plantar ligaments. This tendency is aggravated by the action of the anterior and posterior tibials, which if healthy will draw the arch of the foot up. Thus is brought about a hollowing of the sole of the foot, which is called *pes cavus*. The arch is raised, while the toes and heel are depressed. In treating it several indications are to be met: To aid in straightening out the contracted arch the **plantar fascia**

should be **divided**. The anterior and posterior tibial muscles should not be divided, because in these feet there are already too many disabled muscles. To keep the toes from dropping a **steel sole-plate** and **side-iron brace** should be used **with a stop ankle-joint** allowing flexion, but not extension beyond a right angle. To keep the foot flat on the sole-piece a strap should pass from side to side over the instep, or else particular pains should be taken to lace the foot firmly down in the apparatus. I have also used in these cases an **apparatus with a vertical steel spring**, which allowed a certain amount of both extension and flexion and then brought the foot to a right angle.

For these cases of calcaneocavus Royal Whitman **excises the astragalus and displaces the foot backward**. The **peronei muscles**, if not paralyzed, may be **transplanted into the os calcis** at the same time. For the same condition the writer makes a **transverse horizontal section through the tarsus** immediately below the malleoli and pushes the foot backward, transplanting the peronei muscles into the os calcis or not, as desired. These operations are at present the most useful means we have of treating very badly paralyzed feet.

In 20 cases of severe contracture of the plantar muscles of various origin, an inherited tendency was quite evident in 3 cases; in another family 2 sisters were affected. **Subcutaneous resection of the plantar aponeurosis** is generally sufficient, at least for children, followed by a **plaster cast** and the use of a **screw apparatus**. This suffices in the milder cases; in the more severe it is necessary to **resect the soft parts with a wedge excision in the tarsus, including the four cartilage faces of the**

mediotarsal articulation, or a wedge from the tarsometatarsal articulation. E. Müller (*Beiträge z. klin. Chir.*, March, 1911).

True or essential cavus is rare. Cavus is practically always of neurogenic origin. Leaving out of account the paralytic calcaneus and possibly the congenital types, it is safe to assume that a perversion of the normal reciprocal action between the flexors and extensors of the toes can account for most, if not all, of the remaining types. In the initial stages simple measures commonly suffice to restore the normal balance, while in the fixed deformity severe force, often accompanied by resection of bones and section of soft tissues, is frequently required. C. A. Parker (*Jour. Amer. Med. Assoc.*, Nov. 22, 1913).

PES PLANUS (FLAT-FOOT).—

Flat-foot consists in the flattening of the arch of the foot. It is usually, but not always, accompanied with pronation. Lovett has described a condition in which the symptoms of flat-foot are present with the exception that the arch does not appear to be flattened; to this he has given the name of the "pronated foot;" as its symptoms and treatment are practically those of a mild or early stage of flat-foot, it is included under that subject.

Flat-foot most often occurs in young children and adolescents, but is also common in adults. It has two principal causes: general weakness and rheumatism. There is a disproportion between the strength of the foot and the use it is subjected to.

This balance in the young is usually disturbed by the bodily weakness to which children are so often subject. The weakness of the muscles throws additional strain on the ligaments, and these consequently stretch and

let down the arch. While some patients may exhibit evidences of trouble in other parts of the body, this is often not the case, and the flattening of the arch may be the only evidence of disease that can be detected.

Of the white men who applied for enlistment in the United States army during the period from 1912 to 1915 inclusive, 55 out of every 1000 were disqualified because of flat foot, and but 13 per cent. of the men examined since the outbreak of war were rejected for this reason. A much larger number of men had flat feet, for those with this deformity in moderate degree were passed. A large number of the men who were so passed later appeared on the sick list, because the condition of their feet precluded their engaging in the strenuous exercise incident to the training of the soldier. Brewer (*Monthly Bull. N. Y. State Health Dep. Med. Rec.*, Feb. 16, 1918).

In adults the weakness of the foot is due to pain lessening the efficiency of the muscular support while the fibrous structures lessen their ability to perform their function.

Some, in fair condition, both generally and in respect to the feet, may have their strength overtaxed by excessive use. Thus, children working at occupations requiring them to stand continually, as weaving, will become affected.

There is a form of flat-foot which is acquired by the pregnant woman, and which is not a prominent symptom until she gets up from her bed. This is a tarsalgia resulting from the general arterial relaxation consequent upon lying in bed, and the habit she has formed, in order to keep her balance, of walking with her feet wide apart and resting the weight of the body on the toes instead of the heels, as is normally done. The arch loses its tone, sinks under the weight

of the body, and pain in walking develops. The calcaneum has become sensitive. This condition shows itself as soon as the woman rises from her bed and begins to walk about. It is easily and promptly curable. A **pad under the arch** of the foot, or the wearing for a short time of a **flat-foot plate**, combined with **appropriate exercises**, will accomplish a cure. Tissier and Goutieux (*Réunion Obstét. de Lyon*, May 25, 1909).

Symptoms.—Pain and discomfort are the symptoms most complained of. This may be found generally in the foot, it feeling tired; or it may be localized, common points being often below and in front of the inner ankle or on the dorsum near the ankle, and in the instep generally. The sole of the foot becomes flattened out instead of preserving its natural hollow form. The instep sinks, and the foot on that account looks longer than it really is. It also becomes stiff, losing its flexibility. The peronei muscles along the outer side of the ankle are often in a state of spasm and can be felt as hard cords along the lower end of the fibula and ankle. In rheumatic cases the foot usually looks thicker than normal: this is a characteristic sign, as it shows actual disease present. Pain is marked: often it can be elicited by moderate pressure over the bones and ligaments. Pain in the heel is another characteristic sign, and pains in the soft parts are apt to be present as well as in the bones and ligaments. Another important sign is a sweaty condition of the feet. The age of the patient also aids in diagnosis, and a history of rheumatism or pains in the other joints can often be elicited.

The three cardinal symptoms of insufficiency of the foot are: that long standing is more painful than walk-

ing; that a firm, tight shoe gives more relief than an easy house-shoe, and that the pains vanish as one sits or lies, and sleep is undisturbed. Becker (*Med. Klinik*, March 21, 1909).

Excessive sweating of the feet is a troublesome skin condition frequently seen in flat-foot deformity. This condition is relieved as the foot gains in strength in its corrected position. Varicose ulcer located posterior to and above the internal malleolus is occasionally a complication of flat-foot.

A soft corn between the fourth and fifth toes is almost always associated with transverse arch relaxation. Eczema between the toes, although not common, is always associated with flattened transverse arch. A troublesome fissure located between the fourth and fifth toes is often associated with a relaxed transverse arch and relieved by arch correction. Billings (*Buffalo Med. Jour.*, Sept., 1909).

Flat-foot is a possible cause of synchronous pain in the sacroiliac joints, with relaxation of the latter. Magnuson remarked that: "Probably more women have been operated upon for pelvic trouble because of flat-foot and flat back, than on account of any other poor diagnosis we have made." W. H. Palmer (*Intern. Jour. of Surg.*, xxx, 199, 1917).

Much information may be gained by radiography as to the cause of flat-foot—the "weak foot" of surgical literature—in children. Delayed development of the mediotarsal bones is the cause of the condition. Ethan H. Smith (*Pacific Med. Jour.*, Aug., 1917).

Injuries comparatively rarely cause the affection. Infantile paralysis may cause it, and, if so, other evidences of paralysis will usually be present. Tuberculosis of the foot not infrequently begins with symptoms which are similar to those of flat-foot.

A diagnosis of flat-foot in children should not be made inconsiderately. In 327 out of 440 cases, the foot symptoms were secondary to some other condition, which required treatment. Continued observation in many apparently simple cases showed mild rickets or unsuspected infantile paralysis; less often such conditions as tuberculosis of the knee, hemiplegia, lead, postdiphtheritic, or splastic paralysis. Some are congenital and should more properly be classed with club-foot. Some show evidence of muscular insufficiency resulting from physical debility, which is frequently the sequel of an infectious disease. Prophylaxis of foot disabilities consists in combating the two important causes, rickets and the infectious diseases of childhood. Albert Ehrenfried (Boston Med. and Surg. Jour., April 2, 1914).

Treatment.—The general health should be attended to. Diathetic disorders—such as rheumatism—should receive attention. Any exciting cause—such as excessive work, the wearing of improper shoes, or anything else that may tend to produce or aggravate the conditions—should be remedied. In the young, tonics should be given to build up the general health: strychnine, the hypophosphites, cod-liver oil, quinine, and iron may be given. If the patient has been too closely confined indoors, then a more out-of-door life is to be advised. In endeavoring to improve the local condition it is a good plan to order the patient to rest in bed for a week or two. This eases the pain at once and the spasm of the peronei muscles subsides. Then daily massage and manipulation should be given. This manipulation should have as the main purpose replacing the broken-down arch in its former normal position. To do this the forepart of the foot is

grasped with one hand and rotated from the outer toward the inner side. At the same time pressure should be made with the other hand on the sole of the foot below and slightly in front of the ankle so as to press the arch up. These two movements should be repeated many times twice daily—morning and evening. The foot should also be moved backward and forward so as to unlock the tarsal bones and render the foot more flexible. When the foot has been loosened up, the arch partly restored, and the pain gone, the patient may be allowed to get out of bed. To strengthen the muscles the patient should be told to stand on the toes, raising the heels off the floor as far as possible, several times a day; also to walk on the outer edge of the feet and with the toes turned in.

To relieve the strain on the arch the weight of the body should be thrown on the outer edge of the foot. This is accomplished by raising the heel and sole on the inner side a quarter of an inch or more, also by using some additional mechanical support. This mechanical support may be given either by a separate insole or plate which is inserted into an ordinary walking-shoe or by a shoe which is specially constructed for the patient.

The writer relies most upon his method of strapping, which consists in putting straps over the bottom of the heel about one inch from its posterior banding, placing one-half up the outer surface of the leg without tension and the other up the inner surface of the leg as taut as possible. A short, narrow strap is then placed on the inner surface of the foot, parallel with the sole, and one on the outer surface. This is done with about sixteen strips, one-half by eight inches, each strip slightly overlapping

its predecessor. When all are in place they are covered with about six large straps each one-half inch wide by thirty-two inches, and beginning at the upper end of the leg. The straps will remain in place from four to six weeks; the strapping may be repeated. Ochsner (Jour. Amer. Med. Assoc., Nov. 23, 1907).

In some cases metal plates or insoles work well, but they are often unsatisfactory, and on that account in all serious cases and in many others I prefer a **specially constructed shoe**. The plate usually used consists of a sheet of metal, of the shape of the foot, which has been worked up on its inner edge so as to support the arch. In order to support the outer side of the foot and prevent it from sliding outward away from the plate Royal Whitman has added a projection on the outer side. A leather insole braced with a metal strip can also be bought of instrument-makers. The objection to metal sole-plates is that they are hard to fit and be made comfortable and many of them are liable to rust and break. Practically the only way of preventing the latter is to have them coated with hard rubber after being specially fitted to the patient, or to use some special, non-corroding metal. The shoe which I prefer is made on these lines: a steel shank is inserted between the layers of the sole; over this at the part of the foot which it is desired to support is placed a small pad so shaped as just to fill the hollow of the restored arch. The counter of the shoe is made extra strong; the inner side of the heel is prolonged forward (the **Thomas heel**); the inner edge of the sole and heel are raised a quarter of an inch, and if the case is an exceptionally bad one a small side-plate is

riveted on the sole-plates and goes up on the inner side of the foot for an inch or two. This is covered by sewing over it a piece of leather. The shoe is to be a laced one, and not buttoned. In severe cases a side-iron may be added to this shoe, or an inside plate with side-iron and joint at ankle may be used.

The writer reports three cases of flat-foot with intermittent claudication in men in the forties. The disturbance from the flat-foot had only been aggravated by insoles, as they impeded the circulation in the foot still more. In these as in a number of other cases, great benefit followed application of measures to act on the circulation alone, **superheated air, potassium iodide and heart tonics**. Brandenstein (Berl. klin. Woch., Oct. 21, 1912).

Operation for flat-foot which gave a most satisfactory result on an extreme case. A curved incision three inches long is made behind the outer malleolus down to the os calcis, which is easily exposed by slight dissection and divided close to the ankle-joint with a modified Wyeth saw. The divided posterior part of the os calcis is now slipped down about three-fourths of an inch (if, however, there is any difficulty with this the tendo Achillis should be obliquely divided and lengthened, which can be readily done through the same incision used for sawing the bone). The sawed bone is now nailed in its new position through a half-inch incision over the heel with an ordinary wire nail, two and a half inches long. The improvement in the shape of the foot is noticeable at once. Both feet are put in extension in plaster for about one month. Walking is allowed at the sixth week. In the author's case the nails were removed at the end of the fifth month because they were causing pressure on the shoes. W. P. Carr (Amer. Jour. of Surg., July, 1913).

The laxity of ligaments and joint-capsules in the production of deformity, particularly that of flat-foot, is important. The injection, under local anesthesia, of 0.5 to 1 c.c. (8 to 16 minims) of 4 per cent. **formalin solution** into the lax ligaments is followed by a lasting increase in the supportive power of the affected ligaments, and often by complete cure of the deformity or flat-foot. Immediately after the injection, the part should be immobilized in a **plaster splint** for a week or more in a position to keep the ligaments involved in a state of minimum tension. M. Katzenstein (Deut. med. Woch., July 23, 1914).

Tenotomy of the peronei tendons may be performed, but rarely for cases in which spasm is quite marked.

The following exercises for the treatment of flat-foot, restoring 90 per cent. of the men to ranks cured, was practised at Fort Ethan Allen. Shoes and stockings are removed. The men stand on a raised platform, a 2-inch plank is sufficient; they are then directed to flex the toes to the extreme point of flexion with a hard pull of the flexor muscles of the sole at the extreme point of flexion. This is followed by extension without effort. This is repeated continuously from 5 to 10 minutes, the shorter period at the beginning, gradually lengthening the time until the full time is possible without fatigue. The second exercise is a continuation of this flexion of the toes on the sole of the foot, plus inversion of the foot to the extreme, bringing into the action the *tibialis anticus* muscle. At the extreme point of inversion a *strong, hard pull is made*, then the foot is allowed to resume its usual position without any muscular effort.

At the beginning, 15 or 20 minutes is sufficient for the exercise. Later, after the muscles become stronger, a full half-hour may be devoted to this. The plan is carried out each morning. The patients repeat this performance each night on retiring, devoting one-

half the time consumed in the morning. Many of the cases walk with the toes turned out. They should walk with the toes turned in at all times. This is vitally important. Lieut. H. B. Berry (Month. Bull. N. Y. State Health Dep. Med. Rec., Feb. 16, 1918).

PES VALGUS.—Diagnosis and Treatment.—In valgus the foot is



D. W. Kolbe Co.

Brace for flat-foot, also for toe-drop from infantile paralysis. (G. G. Davis.)

turned out instead of in. It is almost always an acquired affection and associated with calcaneus, as in cases of pes cavus already referred to. Its treatment is a combination of that used for pes cavus and pes planus. The tendency for the foot to turn out is overcome by **stretching** and putting in **plaster of Paris** for a short time,

or by using an **apparatus with a steel sole-plate**, and any tendency to too much flexion or extension is counteracted by a **stop-joint**. The **brace** can either be fastened to and incorporated with the sole-plate or the brace can be separate from the shoe and used inside of it. An advantage of the latter is that it may be used with different shoes, but it is not so efficacious as the former.

KNOCK-KNEE.—In *genu valgum* the legs, instead of being straight in line with the thighs, are inclined outward from the knee-joints. This causes the feet to be wider apart than natural and the knees closer together, so that in walking they knock against each other and interfere in walking; whence the name.

It is caused by an increased obliquity of the lower articular surface of the femur, together, usually, with an increased laxity of the ligaments of the knee-joint. The internal condyle of the femur projects downward farther than does the external. The increase in the internal condyle is on its lower and not on its posterior surface; so that the deformity manifests itself when the legs are extended. When they are flexed they assume their normal position and nothing unusual is to be seen except, in marked cases, the projection of the internal condyle. The increased length of the internal condyle is not caused by a more rapid growth of the extremity of the condyle itself as of the whole substance of the inner side of the femur, for the epiphyseal cartilage is not transverse to the long axis of the femur, but is tilted so as to be almost parallel with the joint surface. Associated with this condition of the bones is also a laxity of

the ligaments of the joint, particularly those on the inner side.

Etiology.—The causes are usually malnutrition, weakness, or rickets, and the affection is often precipitated by some affection of the foot.

Thus when rickets plays a prominent part we find the disease occurring in childhood. When weakness acts as a cause we find it occurring in adolescents somewhat in the same manner as does lateral curvature or flat-foot, but earlier than these two affections. It is often associated with flat-feet, and it can readily be seen how the letting down of the arch of the foot tends to throw the knees inward. This influence, continuing for a long time, at last makes itself evident on the structure of the joint. A condition of valgus occurring from traumatism or other cause, as paralysis, may cause the development of knock-knee, but if there is no constitutional weakness these affections may exist without giving rise to any knee troubles.

Symptoms.—If the condition is once suspected and looked for, there is usually no difficulty in diagnosing it, but it is liable to be overlooked. Attention is apt to be first attracted by either the child's stumbling and falling or else by its awkward gait. In very young children they will begin to stumble and fall frequently or acquire a sort of waddling gait, and this after they have been walking naturally for some time. If on examination flat-feet are found, these may be subjected to treatment and the knees' condition be entirely overlooked.

Prognosis.—Knock-knee is not so apt to improve with growth as are bow-legs, neither does it respond so

readily to treatment. On this account operative measures are more early resorted to.

Treatment.—The **general constitutional condition** of the patient should be **attended to** and remedies—such as **codliver oil** and **syrup of the hypophosphites**—given. **Hygienic** and **dietetic measures** are also important. Considerable can often be accomplished by **mechanical means**, particularly in children under the age of 6 years, when the deformity is not too pronounced.

The form of **apparatus** usually employed consists of a waist-band to which are fastened two leg-irons, one going down on the outside of each leg and fastened to the shoe with a joint at the ankle. The knees are pulled outward toward the leg-irons by straps. Sometimes joints are introduced at the knees. When this is desired greater stability and efficiency is insured by having irons up each side of the leg instead of only the outer. A pad is placed on the inside of the knee and the braces are straightened with wrenches from time to time as necessity requires. It is necessary that each leg-iron be firmly fastened to the shoe and that the shoe itself be strengthened so as to guard against an increase in the tendency to valgus.

When the deformity is marked or the parents are unable to give the case the attention which treatment by means of apparatus entails, then resort may be had to operative means.

The operation employed is division of the bone, or **osteotomy**. Macewen inserts the osteotome on the inner side about a finger's breadth above the tubercle for the adductor-magnus muscle. The division is effected from

within outward. The knee should be bent, as the artery is farther away from the bone in that position. Some make an incision through the skin through which the osteotome is introduced; this is not necessary. A better way is to place the edge of the osteotome on the skin at the desired spot and then by a gentle rocking motion cut through the skin. After completion of the operation a large dressing of gauze is applied, but no sutures need be inserted. The legs are put up in a somewhat overcorrected position, either in plaster of Paris, which is best, or splints. Hahn advocated **division of the bone on the outer side**, and I much prefer it, because the bone is divided on the concave side instead of the convex, thus leaving a bridge of bent bone and periosteum to prevent undue displacement of the fragments, besides being easier of performance. The **operation of Macewen**, however, from the inner side, is the one usually recommended. Cuneiform osteotomy with the removal of a wedge of bone is never done for this affection.

BOW-LEGS.—In bow-legs the concavity of the curve is on the inside instead of the outside of the limbs. Thus, the knees are unduly separated, instead of the feet. The bending, also, is commonly more gradual instead of angular, as in knock-knee.

The causes are much the same, but the affection usually occurs between the ages of 1 and 6 years, and less frequently in older subjects. It is more commonly, also, of distinct rachitic origin. The appearance of the limbs of the patient is so marked that it is less apt to be overlooked than is the case with knock-knees. In the latter affection, as has been said,

a position of valgus is often assumed by the foot. This is turned so as to enable the sole to be placed flat on the ground. In bow-legs the sole has a tendency to incline inward; so that in order to bring the sole flat on the ground the feet are widely separated; therefore the feet are very far apart as well as the knees, and this gives a peculiar appearance to the patient, which is at once remarked by the parents. In-toeing is also present.

The bowing may involve the tibia and fibula alone or the femur in addition. The knee-joint itself is not often affected. The curve is not always a lateral one, but may be in an anteroposterior direction, often combined with lateral bending.

Treatment.—The line of treatment to be pursued depends on the age of the child and the extent and character of the deformity. As the nutrition of the patient is almost always at fault, particular attention should be paid to it. As it is evident that the child has not grown satisfactorily on its previous feeding and mode of life, the usual diet should be changed and the child be gotten out in the open air as much as possible and codliver oil and hypophosphites given internally or codliver oil rubbed thoroughly into the skin daily.

The writer divides bow-legs in small children into mild and severe forms. The former are curable by splints or other apparatus, the latter require division of the bones. In mild cases a suitable splint should be applied and worn by the child while walking about. It should extend from the bottom of the shoe-heel to the line of the knee-joint, be applied to the inside of the leg and ankle over the sock and shoe, and be bandaged on firmly. The bandage should come well down on the out-

side and obtain a purchase from below the external malleolus. The splint is to be applied in the morning and removed at night. It should be worn for from three to twelve months and discarded as soon as the legs are quite straight. Severe cases are treated either by osteotomy of the tibia and fracture of the fibula, or by manual osteoclasis of both bones, in which the limb is grasped by both hands of the operator and broken by leverage over a suitable fulcrum. After a trial of both methods, the writer discarded osteotomy in favor of osteoclasis. Paul B. Roth (Pract., Feb., 1913).

In endeavoring to straighten the limbs by non-operative mechanical means the child may either be kept abed or allowed to walk around. If it is desired to obtain the greatest possible correction in a short time the child is to be kept in bed and the limbs bandaged to each side of a splint placed between them. When the curvature is confined to the bones of the leg a very efficacious method is the following, which I devised some years ago: A pad is placed between the ankles, and these are then firmly fastened together with a bandage; another pad is placed between the knees, and they likewise are bound firmly together. The legs are then covered with a plain muslin bandage and directly across from one leg to the other at the point of greatest curvature is placed a rubber bandage. This by its continuous pressure tends to obliterate the curve. Care should be taken not to apply the rubber bandage too tightly.

If the child is to be allowed to walk around freely braces must be employed. These are often made of a single inside bar. This form, however, is not so firm, nor does it make

so efficacious pressure as does a double brace. It is best to have a brace made with two side-irons jointed at the ankle and knee. A pad is placed over the inside of the ankle, another at the knee, and a third on the opposite side of the leg. By bending the apparatus every few weeks any desired degree of pressure can be obtained. It is highly desirable to carry the apparatus above the knee so that rotation be prevented. A fairly efficient apparatus can be made for very young children without any ankle-joint, as it is hardly so essential in them as in adults.

In cases of anteroposterior curvature an apparatus with two side-irons and a pad strapped over the projecting bone and fastened to the side-irons is of service, but the results are not so good as in lateral curves. *In young children with soft bones* correction can be effected by manual force and the limb placed in a plaster-of-Paris dressing.

In more stubborn cases osteotomy or osteoclasis may be utilized. Personally I do not like osteoclasis in the older cases, and prefer an osteotomy. This can be done through an opening sufficient only to admit the chisel. To break the bone I prefer an osteoclast to manual force, as it necessitates less division of bone. The bone is thus accurately broken at the desired spot without undue violence.

In anteroposterior curvature it is very often necessary to resort to a wedge-shaped resection of bone; this is an operation of considerable gravity, and the utmost care must be taken to employ a reliable aseptic technique.

HALLUX VALGUS.—This is a displacement of the great toe outward; it is usually associated with

enlargement of the bursa and tissues on the inner side of the metatarsophalangeal joint. In its most marked condition the cause is usually rheumatism or rheumatoid in nature, although severe cases occur even when no other symptoms pointing to those affections exist. Trauma and focal infection, with the tonsils as frequent sites of the latter are important causes.

The literature of the subject shows that hallux valgus is regarded as almost always a manifestation of the so-called rheumatic diathesis and "arthritism." Poncet and the writer, however, have indicated its frequency amongst tuberculous subjects and have classed it with localized forms of chronic tuberculous rheumatism. In 1908 Leborgne made personal observations of 51 cases of hallux valgus; 3 were due to nervous disease. Of the remaining 48, tuberculosis was clinically present in 41. Leriche (Rev. d'orthop., Sept., 1911).

In a personal case the patient had had "rheumatism," repeated attacks of tonsillitis, malaria, and gonorrhea. All his toes were hyperextended and in the valgus position. He had a large callus on the plantar surface about the middle of the ball. Röntgenograms showed that the heads of the first, second, third and fourth metatarsals were markedly enlarged especially on the median and plantar aspects. The second and third toes were hammer-toes.

In this case the factors to be considered are trauma and focal infection. The trauma may have played a double part, first by the injury *per se*, and, second by causing a *locus minoris resistentiæ* for the focal infection. The two possible sources of the focal infection are the tonsils, which have been frequently inflamed, and the genito-urinary tract. Gwilym G. Davis (Surg. Clin., vol. i, 671, 1917).

Treatment.—Conservative treatment may be tried with a small in-

ternal lateral splint of covered metal to which the toe is drawn over by adhesive plaster or by means of a metal spring fastened to a sole-plate and made by the surgical-instrument maker. Radical treatment consists in **excising the hypertrophied and inflamed tissues** over the projecting part and **removal of the head of the metatarsal bone**. Care should be taken not to remove too much, or a flail-joint may be left and walking interfered with. For this reason it is preferable not to remove both articular surfaces. The joint can also be straightened by removing a wedge of bone just behind it and transplanting the long extensor tendon more to the inner side.

Case in which the writer used **Mayo's method**—resection of the head of the first metatarsus, removal of exostosis; restoration of joint by inserting flap of synovial tissue between stump of metatarsus and base of first phalanx. Result perfect. Cole (So. Med. Jour., April, 1911).

The writer incises in the web between the first and second toes through which the head of the first metatarsal bone may be dislocated after the capsule of the joint has been opened. The enlarged part of the first metatarsal is nipped off with a bone-cutting forceps in an oblique direction, taking more off on the median aspect of the bone than on the lateral, so that the hallux may be straightened or slightly overcorrected. The lateral phalangeal prolongations of the plantar fascia are further divided and freed. A portion of the capsule, subcutaneous fat, and connective tissue is turned over the cut surface of the metatarsal bone to form a new joint. Second metatarsal is dealt with in a similar manner. To approach the head of the third metatarsal bone and to deal with the callus, an incision is made in the web between the second and third toes.

This incision continues on the ball of the foot to the callus, where it divides to encircle the callus which may then be excised. The head of the third metatarsal bone is removed and a portion of capsule with fat and connective tissue is again turned in over the third metatarsal bone. Dressings are applied and the foot is put in a plaster-of-Paris cast, with the toes in an overcorrected position of extreme flexion. The cast stays on until the stitches are taken out on the eighth day, when a light dorsal plaster-of-Paris splint is reapplied. Gwilym G. Davis (Surg. Clin., vol. i, 651, 1917).

Osteotomy of the metacarpal bone has been done, but it is only effective in comparatively mild cases.

COXA VARA.—This is the name given to a condition in which the neck of the femur is so altered in relation to the shaft that the direction of the thigh is changed. The foot thus may be abnormally everted, and excessive adduction be present, producing a scissors-like deformity.

Osteotomy may be necessary to obviate some of its discomforts and disabilities.

HAMMER-TOE.—This is a permanent contraction or cramping of one or more toes in which they project up above the rest. Corns form on top owing to rubbing of the shoe.

Treatment.—The most effective and surest remedy is to **amputate the toe** at the metacarpal joint. This may seem radical, but, while, by dividing the flexor and extensor tendons and even the lateral ligaments, the toes may be straightened, nevertheless in a few months the deformity is apt to recur.

Relief can often be given by **binding** the affected toe or toes by means of adhesive plaster to a strip of metal or leather beneath.

If **resection** of the joint is performed it is apt to leave a wobbly, loosely attached toe which tends either to be pushed up above the level of the other toes or else to become caught under one of the toes on either side and form a condition of affairs as annoying as was the original affection. The **shoes** should be carefully **looked after** to remove all possible cramping and irritation.

The writer **transplants** the **extensor tendons** into the **metatarsal bone** to preserve the function of that muscle and prevent atrophy of it. The muscle pull raises the metatarsal head and lessens the tendency to one feature in the mechanism of hammer-toe and often relieves an associated metatarsalgia. The **flexors** are **implanted into the base of the first phalanx**. Merrill (Amer. Jour. of Orthop. Surg., Nov., 1912).

WEBBED FINGERS.—When these are congenital they may be cured by raising a wedge-shaped flap from the base of the dorsal aspect of the web and slitting up the remainder. The flap is then turned in between the fingers and sutured in the palm, and the raw surfaces on the sides of the fingers approximated as much as possible.

The essential part of all operations for this affection is to get a healthy strip of skin to heal nicely in the base of the web, thus preventing a cicatricial band forming at this point.

In one of the two families described there were 61 members of the family in the course of four generations, and 14 had pronounced syndactylia. The deformity jumped the second generation and returned in large numbers in the third and fourth. In the other family the deformity was found in 19 of the 33 members. Schlatter (Jour. A. M. A., from Corresp. f. schweizer Aerzte, Feb. 21, 1914).

CLUB-HAND.—This term is applied to a rare condition of the hand corresponding to club-foot. It may be congenital, as a result of defective development, or may be caused by any traumatism capable of inducing paralytic contraction. The congenital variety is usually associated with deformity of the lower end of the radius or ulna and with other congenital malformations. The hand may be fixed in extreme flexion or extension, or it may be deviated laterally, thus constituting varieties resembling those observed in club-foot. In the majority of cases, however, the hand is drawn toward the radial side and flexed.

Treatment.—Passive motion and persistent efforts to place the fingers and hand in their normal position, a retentive apparatus or plaster dressing being used, are sometimes followed by improvements. Frictions and galvanism of the muscles involved tend to assist the curative process. Tenotomy does not enjoy the confidence of surgeons, as a rule, and is thought by many to be more harmful than beneficial. Sometimes **plastic operations, bone implantations, etc.**, are of marked benefit.

GWILYM G. DAVIS,
Philadelphia.

ORTHOTOLIDIN TEST FOR OCCULT BLOOD. See OCCULT BLOOD.

OSSEOUS SYSTEM. See BONES, DISEASES OF.

OSTEOMALACIA. See BONES, DISEASES OF.

OSTEOMYELITIS. See BONES, DISEASES OF.

OTITIS MEDIA. See MIDDLE EAR, DISEASES OF.

OUABAIN. See STROPHANTHUS.

OVARIAN EXTRACT. See ANIMAL EXTRACTS.

OVARIES AND FALLOPIAN TUBES, DISEASES OF.—MALFORMATIONS OF THE OVARIES AND TUBES.—Malformations of the ovary and tube may be congenital or acquired. Both ovaries may be congenitally absent. Absence of the ovaries is generally associated with defective development of the uterus. An individual so affected does not undergo the physical changes incident to puberty, and subsequently more resembles the male. Where one ovary is absent, the corresponding half of the uterus and tube are likely to be deficient in development. The corresponding kidney has also been found absent. A third or accessory ovary is of infrequent occurrence. Constricted portions of the ovary have been mistaken for supernumerary ovaries. Small islands of ovarian tissue have been found upon the peritoneum. Such an anomaly or an incomplete removal of an ovary are undoubtedly the causes of menstruation following oöphorectomy. With absent or partially developed ovaries the sexual functions are never performed normally. The absence of one ovary or its destruction by disease produces no effect upon either sexual desire or conception. It is very important to determine the absence of the ovaries or existence of rudimentary organs, as, when such conditions are recognized, the futility of measures to establish menstruation is demonstrated.

Defective development of the tubes

consists generally in defective development of the fimbriæ at their abdominal ends. One tube may be unusually short or well developed and the other rudimentary. The most frequent alteration is the occurrence of supernumerary ostia, or tubal openings. These may appear as mere apertures or be surrounded by fimbriæ. Defective development usually causes the tube to be unusually convoluted. These convolutions may be so marked as to form strictures which contract the cavity sufficiently to render the woman sterile. In failure of the ovary to descend, the tube may be drawn out at the higher level.

ACQUIRED MALFORMATIONS OF THE OVARIES AND TUBES.—CONGESTION OF THE OVARY.—Acquired malformations of the ovary and tube are frequently produced by circulatory disturbances. They cause hyperemia, or congestion, of the ovary. Such hyperemia occurs physiologically during ovulation and coition. It is not infrequent at the establishment of the menstrual function, especially in those individuals in whom the mental faculties have been developed at the expense of the physical structure.

Marked congestion may result in extravasation of blood into the follicles and stroma of the ovary, more frequently into the former. Such hemorrhages may lead to the follicles being distended to the size of a hen's egg or even that of an orange. This is later converted into a pigment having the consistence of honey, with a chocolate color. Such conditions have also been associated with heart disease, typhoid fever, phosphorus poisoning, and in excessive burns. Follicular apoplexy, as well as ovarian

congestion, mostly occurs in the sexually immature. Such a collection may be absorbed, or the distention becomes so great as to cause rupture of the ovary and a large hemorrhage into the peritoneal cavity. Occasionally a fatal peritonitis may follow.

The tube may undergo alterations in form and situation, while the presence of abdominal tumors, especially ovarian, stretch out the tube or cause it occasionally to attain a length two or three times its normal. The tube may become congested by torsion of the pedicle of a cyst. Moderate congestion simply causes distention of the tube; more marked obstruction of the circulation will result in rupture of small vessels and extravasation of blood into the tube and the surrounding parts. Still more marked, it may cause necrosis of both tube and the tumor.

Symptoms.—Congestion of an ovary and tube is characterized by pain in the corresponding side of the pelvis and will often precede the menstrual flow by a week or ten days. With the establishment of the bloody flow the engorgement is relieved, the pain ceases, and many patients experience greater comfort during the menstrual period. The flow is generally prolonged and excessive, not infrequently amounts to hemorrhage. The patient is weak, pale, and anemic.

Diagnosis.—Such hyperemia should be suspected as the cause of excessive and prolonged menstrual flow near puberty, when the appearance of the patient is characterized by anemia, and she complains of weakness, pain, and tenderness within the pelvis, more marked upon the left side, not infrequently associated with pain in the corresponding mammary gland.

Follicular apoplexy presents no distinctive symptoms, and is rarely recognized.

Treatment.—The progress of the patient will depend upon the **hygienic management**. She should be taken away from school, denied the study of music and the reading of emotional literature. She should be encouraged to take **outdoor exercise**, especially horseback- and bicycle-riding and walking. City girls should be sent to the **country** and **seashore**. The action of the **bowels** should be **carefully supervised** and a **generous diet** given, from which **pastries and sweets** must be largely **excluded**. A **morning sponge-bath** followed by friction with a coarse towel is advisable. During and a few days **preceding the menstrual period** the patient should be **confined to bed**. If the flow is generally excessive the period should be preceded for a few days by the use of **fluidextract of ergot**, f3ss (2 c.c.), **ergotin**, gr. ij (0.13 Gm.) in capsule, a tablet triturate of **hydrastinin**, gr. $\frac{1}{8}$ to $\frac{1}{4}$ (0.008 to 0.016 Gm.), three times a day, or **cotarnin hydrochlorate**, gr. j to iss (0.06 to 0.1 Gm.) every three hours. During the menstrual intervals **potassium bromide**, gr. x (0.6 Gm.), should be administered three times daily, or it might be combined with **potassium iodide**, gr. ij to iij (0.13 to 0.2 Gm.), well diluted. Tonics—such as **quinine**, **strychnine**, or the **bitter tinctures**—are serviceable. The anemia may tempt one to resort to the use of iron, but this remedy is better postponed until hemorrhagic symptoms are under control.

DISPLACEMENTS OF THE OVARY AND TUBE.—HERNIA OF THE OVARY.—Hernia through the

inguinal canal is a rare condition. It is generally found upon the left side. Crural hernia is more frequent, and the ovary has also made its exit through the greater sacro-sciatic foramen and the umbilicus. Chenieux reported an ovarian cyst in the right buttock. Most probably the first surgical removal of the ovaries was performed by Pott for ovarian hernia. Hernia of the ovary is generally secondary, and results from adhesions to the omentum or the intestine. The displaced organs may readily be mistaken for glands or labial tumors. The constant presence of such a tumor; the dull, sickening pain; extreme nausea, and great tenderness should make the diagnosis comparatively easy.

Treatment.—**Taxis** should be judiciously and carefully exercised. An **ice- or sand- bag** should be applied, and, when the reduction has been accomplished, a **truss** should be worn. *When the hernia is irreducible*, the **sac** should be **opened** and the **ovary replaced or removed**.

PROLAPSE OF OVARY.—Prolapse of an ovary and tube is generally dependent upon the position of the uterus. The uterus retroflexed or retroverted, the ovary is no longer supported upon the broad ligament, but hangs from it, and generally lies in Douglas's *cul-de-sac* beneath the uterus. The ovary may be displaced while the uterus retains its normal situation. This displacement more frequently involves the left. Such a displacement is characterized by tenderness and pain during coition and defecation. Pain during the former may be so great as to preclude its performance. The condition is recognized by vaginal

and rectal palpation, in which a movable mass is found which can be pushed upward or whose pedicle can be recognized. The tumor is exceedingly sensitive, and the pressure upon it causes a sickening sensation. The displacement develops chronic inflammation and acute infections may fix the tubes and ovaries behind the uterus.

Treatment consists of **rest, regulation of the bowels, prohibition of the marital relation**, and persistent efforts on the part of the patient in the **genu-pectoral position** to raise the heavy organs from the pelvis. The organs raised may be maintained in place by a suitable **pessary**. Pessaries with heavy posterior bar are more satisfactory, as they fill up the posterior *cul-de-sac* and afford less opportunity for the downward displacement of the ovary and tube. After various pessaries have been unsuccessfully tried, and the patient is still incapacitated for her duties, an **abdominal section** should be performed and **fixation** effected by restoration of the infundibulopelvic ligaments; suturing the ovarian pedicle to the anterior parietes at a point corresponding to the exit of the round ligaments; or puncture the broad ligament beneath the tube and push the ovary through, and suture the opening; the ovary then rests upon the ligament. Descent of an ovary alone does not justify extirpation.

The operation advocated by the writer consists in **pleating the ovarian ligament** by means of a "gathering" stitch, which beginning on the posterior aspect of the uterus, just within the point of origin of the ligament, terminates at its attachment to the ovary. The ligament by this means is not only shortened but thickened,

and the ovary is brought up under the uterine cornu. V. Bonney (Jour. of Obstet. and Gynec. of Brit. Empire, Jan., 1907).

Prolapse of the ovary and tube is very common, where these organs have become considerably enlarged; so that it is not unusual to find tubal and ovarian enlargements behind the uterus.

INFLAMMATIONS OF THE OVARY (OÖPHORITIS).—Inflammation of the ovary is known as oöphoritis, and perioöphoritis when the surrounding peritoneum is involved. They may be either acute or chronic. We find distinctions of parenchymatous, follicular, and interstitial inflammation, but such conditions are not recognized clinically.

ACUTE OÖPHORITIS.—**Symptoms and Etiology.**—The patient complains of intense lancinating pain, generally in the left inguinal region, with marked tenderness, elevated temperature, rapid pulse, and frequent chills. In perioöphoritis symptoms are similar to those induced by mild peritonitis.

Acute inflammation is generally caused by injury, septic poisoning after parturition or abortion, gonorrhea, arsenic or phosphorus poisoning, the exanthemata, acute rheumatism, mumps, and long-continued endometritis. The most frequent cause is sepsis, next gonorrhea. Sepsis is prone to result in abscess. Gonorrhea produces perioöphoritis, with fixation of the ovary.

Acute inflammation may terminate in resolution and disappearance of abnormal symptoms, or in the development of an abscess, its rupture, the occurrence of rapidly fatal infective peritonitis; or the disease may

become chronic; most frequently it is associated with disease of the tube.

Pathology.—In an acute inflammation of the ovary the organ is enlarged, edematous, filled with cysts and the latter with cloudy serum resembling pus. The ovary rapidly attains to three or four times its normal size, is filled with serous fluid, and in the more severe grades with pus, and can attain the size of a man's head, but generally the size of a hen's egg. When inflammation results in the formation of an abscess, its watery contents may be absorbed and leave a cheesy mass. In the milder forms of inflammation resolution occurs. An acute inflammation may be followed by cirrhosis of the ovary from the contraction of the increased connective tissue. Such an ovary may be reduced to the size of a hazelnut. This form of inflammation involves both ovaries, while abscess usually occurs in but one. In perioöphoritis the capsule of the ovary becomes thickened, and the entire organ fixed by perimetric bands of adhesion. Thickening of the capsule renders it less likely to rupture when a follicle matures and a cyst follows. A large number of such follicles form a cystic ovary. The partitions between these break down and cysts of considerable size are formed.

Treatment.—Absolute rest in bed; free purgation by **salines**; tincture of **aconite**, gtt. j to ij every hour; **leeches to the peritoneum**; an **ice-bag over the seat of the pain**; **morphine** by the rectum or hypodermically, sufficient to control the severe pain.

CHRONIC OÖPHORITIS.—Chronic inflammation is much more common than the acute. It occurs during the period of sexual activity

and more frequently in the married. It is a not infrequent result of prolonged engagements. If the ovary is large, contains a number of cysts, with increased fibrous tissue, it is followed by an atrophy known as cirrhosis. It may become fixed in the pelvis by an extensive infiltrate, rendering it immovable, and its situation difficult to discover.

Symptoms—Pain, with its greatest intensity in the groin, and most frequently upon the left side, is persistent, increased by locomotion, misstep, or jolting, and becomes exaggerated as the menstrual period approaches. With free menstrual flow the pain is relieved or disappears. When slight, it increases. Pain extends down the thighs over the sacrum; not infrequently it is experienced in one or both mammary glands. Pain in the groin and symptoms of spinal irritation are frequently present during the menstrual periods. Pain, hysteria, and hysteroepilepsy are associated. Sterility is a constant result. The ovaries—tender to pressure—are not much enlarged. When they are prolapsed, the symptoms are aggravated. Physical examination must be conducted with care. When an enlarged ovary is prolapsed and fixed by inflammatory exudate, a careless observer may mistake it for retroflexion of the uterus.

Diagnosis is determined by finding large sensitive ovaries, increased distress for a week or ten days prior to menstruation, mammary pain, and painful defecation and coition. Rectal examination will be found of service.

Etiology.—Chronic inflammation is a sequel of the acute and due to the same causes; it is also produced by

long-continued congestion from excessive sexual intercourse, masturbation, sexual excitement without gratification, suppressed menstruation, and operations upon the cervix.

Treatment consists in the removal of the source of irritation, interruption of marital relations, interdiction of vigorous exercise or long standing, rest in bed during menstruation, extraction of blood by leeches, counter-irritation with iodine or small blisters, and the internal administration of potash salts—iodide, bromide, or chlorate alone or in combination with bitter tonics. Ichthyol is frequently of service, administered by the mouth, by suppository, or on vaginal tampons; fixation of the ovaries may be overcome by judicious pelvic massage; severe attacks of pain may be ameliorated by tincture of *pulsatilla*, gtt. x four times daily, or fluidextract of *gelsemium*, gtt. v three or four times daily. The faradic current of tension—that is, through a long, fine wire—is said to relieve the pain.

INFLAMMATION OF THE TUBES.—**Symptoms**.—Tubal disease presents no characteristic symptoms. Patients complain of pain, tenderness, and more or less induration of the pelvis as a result of the inflammation in the peritoneum. The uterus, ovaries, and tubes are fixed, not infrequently in a mass which cannot be differentiated; so that we are unable to definitely determine the position and relation of the uterus to the inflammatory collection. The progress of the inflammatory condition, the interference with the nutrition and action of the intestinal canal, and also the absorption of septic matter bring about a lowered state of vitality and a depraved condition of health.

Diagnosis.—The history of the patient and course of the disease would indicate the existence of pelvic lesions. Bimanual examination reveals more or less fixation of the uterus, a mass situated upon one or both sides, or in Douglas's pouch, the contents of the pelvis agglutinated, with a history of pain and tenderness; a recognition of points of softening should enable us to arrive at a diagnosis of pelvic suppuration. A blood count will indicate the virulence of the infection by the leucocytosis. In the less severe inflammation, resulting in an hydrosalpinx, we will find upon one or both sides of the pelvis a retort-shaped mass, with its smallest portion directed toward the uterus and the larger extending outward into Douglas's pouch, which is movable and differs from an ovarian cyst in shape, having a retort- or pear-shape, rather than spherical. Fluctuation may be indistinct, according to the size and tension of the mass.

Etiology.—Tubal disease is most frequently a result of infection, which may follow an abortion or labor, careless examination, or operation upon the cervix or uterine cavity. A more frequent cause is gonorrhea, which travels through the uterus to the tubes and pelvic peritoneum. Another cause is the tubercular bacillus. This latter disease probably occurs more frequently in the tube than in any other portion of the genital structure. Less frequently it arises as a result of syphilis and actinomycosis. The most frequent cause of hematosalpinx is ruptured ectopic gestation with retention of blood in the tube, which subsequently becomes thinned and mixed with mucus. A collection in a tube adherent to an ovary which

possibly contains a number of cysts is likely, upon increase in size of the two collections, to have the intervening wall or septum become so thinned as to break down, the two structures become one, and form a tubo-ovarian cyst or tubo-ovarian abscess according to the character of its contents. As the sac enlarges, its mucous membrane becomes smooth, and the wall gradually thinned until it forms a tumor of considerable size. The sac, as it increases in size, may drop into the pelvis, fill up Douglas's pouch, and rupture, its contents, unless sterile, infecting the peritoneum and causing a localized peritonitis and the formation of a large purulent or serous collection in the *cul-de-sac*.

In a series of 200 cases of pyosalpinx 64.5 per cent. were unsexed just before or at the beginning of their reproductive period. Of the 200 cases, 56 were due to infection by the gonococcus; 56 to infection following abortion; 28 to infection following childbirth; 15 to infection traveling from a purulent appendix; 6 to the tubercle bacillus; 6 to infection following dilatation and curettage done outside the hospital, and in 33 the direct cause could not be ascertained. H. A. Duncan (N. Y. Med. Jour., Feb. 10, 1912).

Several cases showing that infection of the Fallopian tube may occur from the peritoneal end usually as a result of appendicitis. Moore (Med. Rec., Feb. 5, 1916).

Personal case and data from literature indicating that infections of the tube through the blood are decidedly more common than is supposed. Danforth (Surg., Gynec. and Obstet., Mar., 1917).

Pathology.—Inflammation of the tubes occurs in the form of acute and chronic inflammation. Chronic inflammation results in salpingitis, peri-

salpingitis, accumulation of fluid in the tube forming an hydrosalpinx, pyosalpinx, or hematosalpinx, according to the activity of the inflammation and infectious character of the germs. Inflammation consists in, first, thickening of the mucous membrane, frequently desquamation of its epithelium, and enlargement of the tube. The longitudinal folds of mucous membrane, becoming abraded and lying in apposition, infrequently become adherent, forming what appear to be cysts. At other points, particularly in the isthmus of the tube, thickening of the membrane occurs, forming pea- to bean- sized nodules, which are spherical in form, with sharp margins, and give the impression of tumor formations. They are firm in consistence, thick, vascular structures, sometimes also double sided, and symmetrical. This inflammation has been denominated *salpingitis nodosa isthmica*. With the extension of the inflammation to the mucous membrane, increased secretion follows, portions of which are discharged into the peritoneal cavity, producing an inflammatory condition, which causes the plastic material to be thrown out and close up the end of the tube. With inflammation and thickening of the mucous membrane, it becomes contracted and leads to retraction of the fimbriæ; or, by the contraction of the muscular layer it pushes the peritoneum over the abdominal orifice which, becoming agglutinated, closes the opening. Occasionally one or more fimbriæ may protrude, thus leaving a track by which fluid subsequently may escape into the peritoneal cavity. With the closure of the tube the increase of contents causes an obtuse-

ended tumor, which gradually fills with fluid, forming occasionally a pear-shaped mass, or, where its walls are in places constricted by an increased amount of fibrous tissue, a sausage-shaped tumor is formed. This sac, when its contents are serous, is an *hydrosalpinx*, and occasionally becomes greatly distended, forming a sac as large as a child's head, which increases in size toward the abdominal end, and presents a thin-walled tumor which is more or less free, and about which adhesions may be entirely absent. In a more acute infection the contents become purulent (*pyosalpinx*), and we have an inflammation extending through the wall of the tumor, involving its peritoneal surface, and not infrequently causing extensive peritoneal inflammation by which everything in the pelvis is matted together. Such a sac may subsequently rupture, spread out the broad ligament, and form a pelvic abscess of considerable dimensions.

When the adhesions between the intestine or bladder and sac are firm, rupture may occur either into the intestine or bladder and decrease the tumor by the discharge of the pus; or the wall may become so thinned as to permit its discharge through the abdominal walls, into the vagina, or more seriously into the peritoneal cavity, when it may be followed by rapidly fatal septic peritonitis. When the sac empties into the bladder or intestine, it does so at a level which does not permit drainage of the entire sac and consequently it is only the overflow that escapes. The patient is subjected to a long-continued drain, which results in increased anemia and debility.

The writer found records of only 20 cases of tubal fibroma and none in which the growth was on the abdominal end of the tube as in the case he reports. It had not induced any symptoms until torsion of the pedicle caused sudden severe illness and an operation under the diagnosis of appendicitis. Herde (*Correspondenzblatt f. schweizer Aerzte*, May 25, 1918).

In a study of 200 cases of tuberculous salpingitis, it was found in nearly 1 per cent. of all women admitted to the gynecological service of the Johns Hopkins Hospital, $1\frac{1}{2}$ times as frequently among colored women as among white.

Out of every 13 abnormal tubes removed at operation, 1 was tuberculous.

Nearly $\frac{3}{4}$ of the patients were between 20 and 40 years of age.

Sixty per cent. of the married patients were sterile. A family history of tuberculosis was reported in 22.5 per cent. of the cases, while in an additional 2.5 per cent. the consort had active pulmonary tuberculosis.

The chief complaint was pain (74.5 per cent.). Usually this was situated in the lower abdomen (82.5 per cent.); leucorrhea (72 per cent.); nearly $\frac{1}{2}$ had dysuria, nycturia, or pollakiuria; more than $\frac{1}{2}$ were constipated; $\frac{1}{2}$ had lost weight during their illness.

The physical examination of these patients presented no characteristic findings. About $\frac{1}{4}$ had pulmonary tuberculosis.

The prognosis of the condition is grave in the presence of tuberculosis elsewhere in the body, when there is fever, and when the peritoneum is involved.

The operative mortality was 7.6 per cent.

Follow-up letters, etc., showed that of 90 patients, 78 were living from 2 months to 30 years after the operation. Nearly all alive were in good condition. J. P. Greenberg (*Bull. Johns Hopkins Hosp.*, xxxii, 52, 1921).

Treatment.—The treatment must be directed to the present condition. If the attack is acute efforts should be employed to bring about a subsidence of the acute symptoms. Confine the patient to **bed**, administer **purgatives**, and apply an **ice-bag**. When the acute symptoms subside, the temperature becomes normal, the pain and tenderness to pressure lessened, substitute **heat** for cold. This may be employed by fomentations covered with oiled paper, muslin, or silk, maintaining the heat by a hot-water bottle or an electric pad. If suppuration has not occurred the process of resolution and absorption may be promoted by **pressure** in the form of bags of shot or through the practice of **pelvic massage**. Patients suffering from attacks of what promise to be destructive conditions may, by the judicious employment of these measures, secure effective resolution and be completely restored to health. Even with the formation of pus, when it is walled off, the acute symptoms may subside, the pus collection may clear by sedimentation, the heavier portions, as the corpuscles, be deposited upon the wall of the sac, and a serous collection be substituted for the pus.

In early cases, particularly of gonococcic infection, the woman should be put to bed, and the vagina irrigated every 2 or 3 hours with 2 per cent. **phenol**, 1:4000 **bichloride of mercury**, or 30 minims (1.8 c.c.) of **Lugol's solution** to the pint (500 c.c.). These irrigations should be hot and the vulva kept covered between treatments with a pad moistened with 3 per cent. phenol or 20 per cent. alcohol solution. The bowels should be kept open, and an **abundance of**

water given. If there is evidence of pelvic involvement, **ice-bags** should be continuously applied. On the subsidence of acute symptoms hot applications should be used to promote absorption. In addition it is well to cleanse the vagina through a speculum and paint it with **tincture of iodine** or a 2 per cent. solution of **silver nitrate**. It should then be packed with **iodoform gauze**. Pus in the pelvic cavity should be evacuated, if possible, through vaginal incision and drainage.

Results of intrauterine injections as the treatment is carried out in the Zweifel clinic at Leipzig: A 2 per cent. solution of **argentamine** which is non-irritating and anti-gonorrheal is used. The 123 cases treated, the lesions varying from simple salpingitis and perisalpingitis to pyosalpinx the size of a fist, were divided into two groups: 1, the relief of pain, and, 2 alterations in objective findings. Under the first heading 108 (88 per cent.) were completely relieved, 7 markedly improved, while in 8 slight or no improvement was obtained. Based upon the objective findings, 89 (72 per cent.) were cured, 16 showed marked improvement, 18 showed little or no improvement, and the condition was exaggerated in 1 case. Of the pyosalpinx cases 86 per cent. were cured.

As to remote results: Of 30 patients who had received no treatment for one year to nineteen months, 84 per cent. were cured; 20 patients after six months to one year, with 82 per cent. cures; and 26 patients after three to six months, with 76 per cent. cures. Of this number 5 have become pregnant. In the presence of acute infection, fever, or objective symptoms the treatment is contraindicated. The first three or four injections must be made slowly and under little pressure on account of the pain produced. The subsequent

daily injections are, as a rule, painless and greater pressure can be employed. The amount injected varies from 1 to 2.5 c.c. (16 to 40 minims). In severe cases the pain following injection was so severe as to demand morphine. Erich Aulhorn (Archiv f. Gynäk., xc, 15, 1910).

Statistics based on the clinical material of 6000 cases treated in the clinic of Schauta. **Conservative methods** were usually attended with excellent results, and operation (usually total extirpation) resorted to in only about 10 per cent. of the cases in which there were large accumulations of pus or complications. The vaginal route was ordinarily preferred owing to its lesser mortality, particularly in the presence of virulent pus organisms. **Abdominal section** was reserved chiefly for chronic cases with firm adhesions. Sometimes **salpingectomy**, with preservation of the uterus and one or both ovaries when healthy, gave good end results. The percentage of permanent cures from radical operation was 93.5 per cent., from conservative abdominal operations under favorable conditions 72.2 per cent. Thaler (Archiv f. Gynäk., Bd. xciii, Heft 3, 1911).

The writer recommends, in acute inflammation of the uterine adnexa, **hot moist applications**, with or without the following liniment:—

℞ *Extracti opii*,
Extracti belladonnæ
foliorumāā 3j (4 Gm.).
Extracti hyoscyami,
Chloroformiāā ʒss (15 Gm.).
Olei olivæ ʒiiss (75 Gm.).

Misce. Fiat linimentum.

The patient should be kept absolutely quiet **in bed in the horizontal position**. If the temperature is high and the pain severe, local blood-letting by means of **wet cupping** or **leeches** should be practised. **Injections of hot water** also constitute a useful measure. The receptacle should hold 2 liters (quarts) of water and must not be over eighteen inches

above the level of the bed. A. Robin (Nouveaux remèdes, June 8, 1913).

Referring to 25 women with genital tuberculosis, for which he had operated from 15 months to over 4 years before, the writer states that 2 had since died; 5 presented unsatisfactory objective signs, though feeling well, while 18 were practically cured, their earning capacity being restored. Differential diagnosis is deemed immaterial, as the clinical picture of chronic disease in the uterine adnexa always calls for a **laparotomy**. If adhesions contraindicate excision of the focus, intervention must be limited to **local medication** of the abdominal cavity. One should wait until the temperature is normal before operating. Kröner (Arch. f. Gynäk., cv, Nu. 2, 1916).

The writer recommends **dehydrated magnesium sulphate** *i.e.*, the sulphate relieved of water of crystallization by heat, to relieve the pain in acute salpingitis. One-half ounce of the salt is placed against the posterior wall of the vagina and held in position by a tampon of absorbent cotton. This procedure is repeated every 24 hours for a period of time varying from 6 to 12 days. Rest, a light diet and a saline laxative are given. Butt (Jour. Ark. Med. Soc, xiv, 105, 1917).

While all are agreed that the retention of an infected uterus, after removal of infected tubes, is a menace to the woman's future health, the writer believes that the care taken to preserve ovulation should also apply to that of menstruation, as ovulation without menstruation contributes little to the patient's well-being. Sections through the uterus between the fundus and internal os show practically no pathological changes in these inflammatory cases, but the greatest pathology in the uterus is to be found in the cervical glands and in the fundal region and pars interstitialis of the tube. To clear the patient from these infective foci, many operators perform a panhysterectomy, which, to be sure, entirely rids the patient of the infection, but also de-

prives her of further menstrual flow. To obviate this unpleasant sequel, but also rid the patient of her infection, the writer treats the cervix by linear cauterization or excision following which he attacks the tubes and fundus of the uterus by the method of Beutner and Bell, which consists of the ablation of both tubes with resection of the infected fundus of the uterus, leaving sufficient healthy uterine body to conserve the menstrual function and one or both ovaries to continue ovulation. The operation should be done without interfering with the ovarian circulation, hemostasis being secured by the ligation of the individual branches supplying the tube and fundus. Polak (Jour. Amer. Med. Assoc., lxi, 1938, 1917).

Extra care must be exercised in the treatment of cases in which pus has occurred that the infective processes are not extended. **Rest** is imperative; manipulation must be carefully avoided. The **intestinal canal** should be **kept open** to promote by it the drainage of the pelvis. Judicious **nutrition** should be maintained, but stimulation avoided. Where large inflammatory collections, whether serous or purulent, are present no hope for permanent relief can be expected until the **collection** is **evacuated or removed**. The method of treatment, however, will depend somewhat upon its situation and size.

A large collection filling up Douglas's pouch, or distinctly recognized through the vagina, is preferably attacked by **vaginal incision**, in order to remove the large quantity of infectious material without disturbing the barriers nature has erected for the protection of the peritoneal cavity. Collections of pus may be evacuated by free **vaginal incision**, through the posterior vaginal fornix;

the **sac exposed and incised**, by which its **contents are evacuated**. The **sac** is thoroughly irrigated, and an examination made to determine the existence of further collections. If any exist, they are opened and evacuated. Where the **sac** is readily separable it may be gradually drawn down and be **removed** through the vagina. If, however, there is more or less fixation of the thoroughly opened and irrigated sac, it is **packed with iodoform gauze**, which is permitted to remain the greater part of the week, when its **cavity is irrigated**, after removal of the packing with 1 to 2 per cent. **salt solution** and repacked. The procedure should be repeated every few days until the sac has contracted, when it may be omitted.

Occasionally this procedure will result in obliteration of the sac and cure of the patient. Such an attempt should always precede an **abdominal section** whenever there is present a large collection of pus that can be reached *per vaginam*. The only objection to the plan of treatment is that it is not always curative; a secreting surface remains and the sac may again close and refill. The most effective procedure is to open the abdomen, **break up the adhesions**, and **remove the infected tube and ovary**. The exposure of the field can be greatly enhanced by placing the patient in the Trendelenburg posture, by which the sight as well as touch may be exercised in the enucleation and removal of the mass, but the danger of spreading infection to the healthy surfaces is increased; consequently, it is better to wall back the intestines with gauze packing through a free incision and complete

the procedure with the patient on a level table.

While **extirpation of a tubal sac** is the proper treatment in large collections, whether of blood, pus, or serum, abdominal section should not be considered as required in every case of tubal inflammation. In the slighter forms of disease, and in the early stages, the **hygienic measures** already indicated, supplemented by palliative **curettement** and **uterine drainage**, will often be sufficient to establish resolution in the slighter forms. The maintenance of uterine drainage will frequently be sufficient to establish a cure, both clinically and functionally. In other words, patients who have had extensive tubal inflammation of gonorrheal origin have recovered and subsequently given birth to children. I have observed this sufficiently often in my own practice to make this assertion without question. Occasionally the uterine end of the tube remains patulous, permitting, in certain positions of the body or in overaccumulation, the evacuation of the sac through the uterus when it is no longer palpable until it again refills. This condition is known as *hydrops tubæ profluens*.

The extension of inflammation from the uterus to the tubes and the changes in that organ resulting from inflammation prior to the removal of the tubes, which not infrequently continue nervous and other manifestations, led Péan and his followers to advocate the removal of the uterus *per vaginam* whenever a condition existed demanding the removal of both ovaries. **Hysterectomy** may thus be done either by clamp or ligature. The clamp procedure is the more expeditious. The ligature, while

longer, is safer, and free from the disagreeable odor during convalescence incident to the sloughing tissue devitalized by the clamps.

The operation consists, first, in thorough cleansing and disinfection of the vagina. The cervix is seized with a double tenaculum, and the vagina incised with scissors, knife, or—preferably—with a thermocautery knife. Incision with the latter prevents hemorrhage from the vaginal wall and promotes drainage through the longer duration required in the union of the vaginal wound. The incision completely encircles the neck of the uterus and may extend one-half to three-fourths of an inch on a line posteriorly to the broad ligament. Pus collections in either the tube or Douglas's pouch should now be opened and thoroughly evacuated, and the cavity irrigated before the adhesions are broken up, thus removing an extensive source of infection.

The separation of the bladder from the uterus is accomplished by blunt dissection and the tissues are pushed off posteriorly in the same manner until the peritoneum is reached. By blunt dissection, we may frequently strip out a good portion of the cervix without any necessity for ligating vessels. Having reached the peritoneum in front and behind, a fold of the broad ligament is then secured on either side by ligature or a clamp, and incised, which sets free the cervix. We may now proceed to drag down the cervix, ligate and cut the remaining portions of the broad ligaments on each side in a similar manner, or the cervix may be amputated and the fundus of the uterus rotated downward through the anterior incision. This procedure permits the passage of

the finger over the fundus, to follow up the broad ligaments, and accomplish the enucleation of the ovary and tube. The ovary and tube are usually prolapsed backward from their weight, and this maneuver renders them tense and enables the operator with the finger to follow more readily the line of cleavage between the tube, ovary, and the other tissues.

After the sac is separated and enucleated, the remaining portion of the ligament is ligated and cut. This is usually first done upon the left side, which affords more room to follow the same procedure upon the right. If ligatures are used they should be firmly tied, and the ends cut to prevent traction, which may pull them from the stump. A retracted vessel may be quite difficult to pick up and traction upon the stump may permit the ovarian artery to slip back and cause severe and even perilous hemorrhage. In addition to ligation the stumps are temporarily held with clamps, so that they may not be retracted beyond reach when we desire to close off the peritoneal cavity from the vagina.

The final steps of the operation consist in careful inspection of the wound for bleeding points, irrigation of the wound and vagina with a normal **salt solution**, by which the blood and discharge are completely removed. In the majority of these cases extensive tearing and denudation have been necessary, which will result in the escape of serum or even blood; it is consequently preferable not to close the vaginal wound, but to pack the cavity with iodoform gauze. This gauze packing is permitted to remain from six to eight days. When removed, plastic exudation,

which has been thrown out around it, will hold up the intestines and prevent their prolapsus. It is better, however, to replace the tampon by a smaller one, which is permitted to remain for a few days. The ligatures should be catgut, as silk is almost certain to become infected, and will prove a source of irritation until the sutures are finally thrown off or disintegrate. Catgut sutures are of much shorter duration and much less likely to cause trouble.

The vaginal operation is not applicable to all cases. It should not be preferred when there is any hope of saving the uterus and the appendages of one side. It is only in those cases in which the examination has demonstrated the necessity for the sacrifice of both ovaries and tubes, that the extirpation of the uterus should be considered. Where a partial operation is done, the preferable route will be by the abdomen, which permits us the better to inspect the condition of the peritoneal cavity, to break up adhesions, and suitably treat the partially diseased structures which are retained.

In the treatment of chronic salpingitis the following conservative measures are recommended: **Vaginal douches** of water at 110° F. (43.3° C.), twenty minutes in duration and repeated twice daily, are given in the recumbent position. **Glycerin** (93 parts) and **ichthyol** (7 parts) **tampons** are applied daily. Combination of the douches and tampons affords the most effective means of depleting the congested pelvic tissues. Under the treatment tenderness and pain are relieved, inflammatory swellings are reduced, and the functions of the tubes and neighboring organs are in part or wholly restored. Under this treatment, extending over a period of one year, he has seen a case of bi-

lateral pyosalpinx arrive at a functional cure, and to the degree which provided for pregnancy and a successful delivery. **Pelvic massage**, properly directed and persisted in for the requisite time, will bring favorable results in selected cases, but in America this method of treatment has found little favor. He has personally found little satisfaction in it. Palmer Findley (Interstate Med. Jour., Dec., 1908).

In gonorrheal pyosalpinx the writer advises **rest in bed**, **attention to the bowels**, and **Priessnitz applications to the abdomen**. If the fever has subsided after eight to fourteen days, the application of heat in the form of **hot irrigations** at 45° to 48° C. (113° to 118.4° F.), in amounts of 8 to 10 liters (quarts) every other day or every day, are indicated. **Hot-air baths** are also good, but all these measures should be discontinued as soon as the patient reacts with temperature or increased pain. As soon as the process retrogresses, prolonged **sitz baths**, with the addition of 2 to 5 per cent. salt, do good service. Various drugs have been recommended for use in the vagina. Among these are **sulphur**, **ichthyol**, and **iodine**. **Abundant nourishing food** and **general tonic treatment** will often help the patient to combat the infection. In a very large percentage of cases, this conservative treatment will lead to a cure; in a minority the fever and pains do not subside, and soon a boggy mass can be felt in the sac of Douglas. This should be opened from the vagina and the finger should be introduced after **incision**, so as to **break open all partitions**. Opitz (Medizin-Klinik, Jan. 8, 1911).

Evidence of pus in the tube, uterus or ovary is not an imperative indication for the removal of these structures any more than it is for the removal of the analogous pathology in the male. Often the symptoms produced by the precipitated menopause are more distressing, and more dangerous, than those of the pyosalpinx. The writer has yet to see any

one of all sorts of infectious agents that was not relieved or, at least, decidedly benefited by **vaccine treatment**. That contrary to certain opinions it is not only a temporary partial relief, but in the writer's experience the results have been permanent and the relief complete. Farbach (Ky. Med. Jour., Sept. 15, 1912).

TUMORS OF THE FALLOPIAN TUBES.

BENIGN GROWTHS.—Tumors of the tubes and ovaries may be benign or malignant. The benign tumors of the Fallopian tubes are exceedingly rare, excepting those which are the products of inflammatory changes, and have already been described.

Fibroma, or myoma, of the tube is an infrequent growth, and attains to small size. It arises from the muscular tissue of the tube, and may grow within or become subperitoneal; it rarely obstructs the caliber of the tubal canal. Inflammatory and tuberculous changes have sometimes been mistaken for this growth, particularly the condition known as *salpingitis nodosa*.

Recklinghausen has described a form of fibroma characterized by fibroid constituents and including glandular structure. This growth is attributed to vestigial remains.

Fibrocyst of the tube is so rare that but a single case has been described, that of Snger-Barth, which consists of three tumors, the conglomeration of various large cysts, firm tumors that were in part pedunculated from the fimbrie of an otherwise healthy tube. Under examination the products greatly resemble a teratoma.

Enchondromata are small, cartilaginous masses found in the ends of the fimbria.

Dermoid cyst of the tube is exceedingly rare. Ritchie described one which contained a plum-sized bone. Pozzi has also described a dermoid cyst removed from the tubal wall. Cysts of small size are frequent. The large irregular bulle so common in association with fibroid growths are said to be dilated lymph-spaces. Cysts which vary in size from a pea to a walnut are found in the walls of the tube, but most frequently beneath the peritoneum. Cysts within the tube are generally the result of adhesions of adjoining folds of mucous membrane.

Polypus is a rarely recognized growth. Lewers reports a case in which the inner surface of the tube was studded with such growths varying in size from a pin's head to a pea.

Papillomata of the tube, considered as adenoma by Sutton, are allied to the condylomata, or warts, of the vulva; they consist mainly of epithelium. These growths are difficult to differentiate from sarcoma and cancer, but are evidently benign.

MALIGNANT GROWTHS.—**Carcinoma** of the tube may be either primary or secondary, though the latter is much the more frequent. The secondary involvement may take place from either the ovaries or the uterus. Doran divides primary cancer of the tube into two forms: where the cancer first develops in mucous membrane of a normally formed tube; second, where it forms in a malformed tube, bearing a cyst whose wall becomes infected.

Sarcoma of the ovary is frequent; of the tube very rare. Sarcomatous nodules are sometimes found scattered over the peritoneal surface of

the tube, but it more frequently passes from the ovary to the omentum. *Deciduoma malignum* can occur in a portion of the placenta or chorion of the tube. It forms in the tubal sac as readily as it would in the placenta or chorion of the uterus. The possibility of such an occurrence is urged by Säger as an additional argument for active interference for the extirpation of tubal moles and the appendages after tubal abortion.

TUMORS OF THE OVARIES.

These tumors differ from the other neoplasms in their greater propensity to malignant degeneration, often rendering it difficult to determine whether the individual growth is malignant or benign; consequently we will discuss the two classes of tumors together.

CLASSIFICATION.—Tumors of the ovary are divided clinically into *cystic* and *solid*; pathologically into *simple*, *proliferating*, *dermoid*, and *parovarian*; by size, into *small* and *large*. The cystic comprise the simple, proliferating, and the dermoid. Solid tumors, less frequent, are the fibromata, sarcomata, and carcinomata. Cysts may originate in any part of the tubo-ovarian structure, as the cortical, medullary, and parenchymatous portions of the ovary, and in the structure between the tube and ovary known as the Rosenmüller organ, or parovarian structure, of which the hydatid of Morgagni, the extremity of the canal of Müller, is an example. Cysts which develop in the folds of the broad ligament are known as broad-ligament cysts.

CYSTS.—Cystic growths attain almost unlimited size, larger than any

other growth, and occasionally the body seems but an appendage to the tumor. They rapidly reach the weight of one hundred pounds. Maritan recently reported an ovarian cyst weighing two hundred pounds, removed from a woman who had previously weighed two hundred and ninety pounds. Her girth measure was ninety inches. Solid tumors closely retain the shape of the ovary; cystic are irregularly spherical,—the larger they become, the more spherical. The surface of the cyst is a bluish white, greenish, brownish, yellow, or a glistening white. Secondary developments in the cyst wall may give it an irregular shape. Cysts are still further divided into unilocular, or single cysts, and multilocular, where the cysts are divided into a number of cavities or smaller cysts within its walls.

The contents of the various tumors greatly differ. Indeed, the different cysts in the same tumors show radically different contents. In the unilocular tumors the contents are usually clear and limpid; in the multilocular, thick, viscid, and glue-like. In some chambers it may be clear and limpid, in others thick and viscid, or, again, mixed with pus, blood, or fat. Cysts of the broad ligament are generally unilocular and contain clear fluid. Those which originate in the hilum are papillary, and those from the parenchymatous structure of the ovary glandular. The small cysts are described as: first, small residual cysts which develop from the horizontal canals of the parovarium, with which may be included the hydatid of Morgagni; second, follicular cysts; third, cysts of the corpus luteum; fourth, tubo-ovarian cysts.

The large cysts are: first, the glandular proliferous; second, the papillary proliferous; third, the dermoid, simple and mixed; fourth, parovarian, including several varieties, as hyaline, papillary, and dermoid.

Small residual cysts develop in the structure between the tube and ovary, known as the parovarian structure, or organ of Rosenmüller. Those originating in the vertical tubes have ciliated epithelium, and may subsequently develop into papillary growths. They are detached from the ligament and hang from the peritoneal surface by a slender pedicle. Attached to the fimbriated end of the tube is generally found a small cyst varying in size from a pea to a cherry, known as the *hydatid of Morgagni*, which from its almost constant presence is regarded as a physiological cyst.

Follicular cyst, or *hydrops folliculorum*, are small cysts which are unilocular, dilated follicles, generally multiple and small. In an ovary which has not attained twice its size, fifteen to twenty of these cysts are often found. They were long considered as the sole source of large ovarian cysts, but it is in rare instances only when they attain the size of a fist, occasionally that of a man's head. The contents of the cyst are generally clear, may be blood-stained, and have a specific gravity of 1.005 to 1.020. The cyst wall is a transparent, thin membrane of light-gray color, covered with columnar epithelium. The ovarian stroma may be excessive or the reverse. In the latter condition the ovary is frequently converted into a mass of delicate cysts. The disease is generally bilateral. These cysts are unruptured and dilated

Graafian follicles. In the smaller ones ovuli may be detected. Failure to rupture and increase of fluid contents increase the atrophy of the follicle. Rupture may be prevented by undue thickness, or toughness, of the ovarian wall, which results from inflammation, or deposits of exudation upon the surface of the ovary. It also is caused by a deep situation of the developing follicle, or a very slight congestion, insufficient to furnish proper secretion to produce rupture. These cysts have been found in an ovary prior to menstruation; indeed, in the fetal ovary. They rarely give rise to symptoms.

Many of the so-called simple or serous cysts of the ovary are in reality of inflammatory origin, by far the most important type of inflammation in this connection being tuberculosis. The writers have observed that not infrequently ovarian cysts, showing themselves absolutely nothing characteristic of tuberculosis, occur in conjunction with tuberculous tubal or peritoneal lesions; they had, for instance, a case in which a cyst the size of an adult head, containing 2 liters (quarts) of sero-sanguineous fluid, was attached to a tube showing distinct tuberculous changes, but without suppuration. Pollosson and Violet (*Lyon Chir.*, x, 340, 1913).

The writer has done conservative operations on 338 women. Of 190 supplying reports, 60 were unmarried and 46 of the remaining 130 reported pregnancies. The writer resected cystic ovaries, but preserved all healthy stroma, suturing accurately with fine catgut. He tries to so separate adhesions, embedded ovaries, and tubes as to leave the least area of raw surface; hanging up prolapsed ovaries, plicating the ligaments, so readjusting uterus, tubes, and ovaries as to approach the normal. McRae (*Jour. Med. Assoc. Ga.*, vi, 158, 1916).

Cysts of the corpus luteum are unilocular cysts the size of a pigeon's egg, occasionally that of an apple. They were described by Rokitansky, and it was supposed they could only occur in the corpus luteum of pregnancy, but they have been found in the nullipara.

TUBO-OVARIAN CYSTS.—

These arise from contact, with the distended tube adherent to a cyst of the ovary. The increasing pressure of the accumulating fluid gradually absorbs the thin septum, and the two sacs form one cavity, the smaller portion of which is usually formed by the tube. The uterine end of the tube can remain permeable and, as the fluid increases, permit the overflow to drain through the uterus. Such a condition is known as a *profluent tubo-ovarian hydrops*, which resembles *hydrops tubæ profluens*. The open tube acts as a safety-valve and prevents increase from distention of the cyst.

LARGE CYSTS.—Proliferating cysts comprise the great majority of ovarian tumors and vary in size from an egg to that of a tumor weighing over one hundred pounds, which fills up the abdomen and encroaches upon the thoracic viscera. The surface of the cyst presents a pearly white, glistening appearance, the thinner portions of which are purple, green, or black, according to the color of their individual contents. The external surface may be smooth or covered with papillary growths or mucous vegetations. The glandular proliferous cysts are highly organized and richly supplied with blood-vessels and have the faculty of budding or generating new cysts from within the original growth. They may be

spherical in shape and regular in outline, simulating a single cyst, or be irregular from numerous nodules, which indicate a multilocular tumor. These growths generally have a distinct pedicle, which is the attachment of the tumor. The pedicle may be long or short, thin and band-like or broad and thick. Occasionally the tumor is sessile. The latter are frequently intraligamentary. The pedicle is developed by the traction of the tumor and the resulting hyperplasia of the ovarian ligament and stretching of the meso-ovarium. The tube generally remains separated by its mesosalpinx from the tumor, while the ampulla is often fastened to or approaches the sac. The tube is usually elongated. In ovariectomy the tube is generally removed with the pedicle. The pedicle varies in length from four to twenty centimeters; in breadth, from two to twelve centimeters, and may be entirely absent. The absence of the pedicle depends somewhat upon the variety of the cyst. In glandular, the tendency is to a long pedicle; in papillary, to short or absent pedicle; and in dermoid it is short and strong.

Structure.—The internal structure of glandular cysts justifies their division into the areolar, unilocular, and multilocular. The glandular cysts, Virchow says, originate from the invagination or proliferation of the epithelium in the stroma. Continuation of these processes causes the formation of a many-chambered, glandular, or adenomatous cyst. An areolar cyst is a conglomeration of small cysts, with thick, well-developed and vascular stroma. A number of cysts may have ruptured to form a considerable-sized one or

the entire tumor may be made up of a large number of small masses, none of which will exceed the size of a plum. Unilocular cysts often attain an enormous size, but examination will disclose evidence of a previous division into numerous smaller cysts; so it may be asserted that all unilocular cysts originate from multilocular ones. A careful investigation will usually disclose small cysts in the wall, not infrequently the remains of septa in its cavity. Multilocular cysts contain a number of cysts of varying size, so arranged as to present the appearance of a single tumor. By the increase of the individual sacs, their intervening walls gradually become thinned until one after another they rupture, and the sacs coalesce to form larger single chambers. These remains of septa become still more stretched as the tumor increases in size, until they present only a cord-like surface on the inner margin of the tumor. Occasionally the vascular structure alone remains to indicate the former septum. In sudden rupture vessels of the septa are torn and extensive hemorrhage may follow, changing the character of the sac contents. Upon examination of a large cyst we usually find a wall with three layers, the outside consisting of pure connective tissue like the albuginea of the ovary, the middle of loose connective tissue with numerous large vessels, while the inner is rich with cells and contains numerous small vessels. The external surface of the cyst is covered with columnar epithelium, and is lined with one layer of cylinder epithelium, which presents different forms in different tumors, and by its structure governs the character of the secretion in the

various sacs. In the larger cyst the epithelium undergoes degenerative changes, through thinning of the septal wall. Fatty or albuminous changes cause the epithelium to disappear entirely from the wall of one or more of the larger cysts. Pfannenstiel has directed attention to the possibility of the formation of papillary growths in the glandular cysts. These growths may be sparsely distributed from the inner surface of a large cyst; in others they appear as circumscribed tufts in one side of the cyst, while the remaining portion is smooth, or, again, the entire cavity may be filled with strong, branching growths, while the quantity of fluid is very scant. The larger the cyst, the greater the probability that a large portion of the wall is smooth. Cyst contents often present a very great contrast in color and consistence, as almost colorless, a straw color, green, purple or black, thin or thick, viscid or gelatinous. The contents of the various cysts in the small tumor differ in color and consistence; in some the fluid will be thin and in others so viscid that it will not flow. The contents of smaller cysts are more consistent, and become thinner as the cysts increase in size. The specific gravity of the fluid varies from 1.002 to 1.020, with an average of 1.012. The fluid, however viscid it is, is absolutely structureless. It contains blood-corpuscles, epithelial cells, and crystals of cholesterin, while its reaction is neutral or alkaline. Upon analysis, various forms of albumin, metalbumin, paralbumin, and albumin peptone are found.

Papillary proliferous cysts present marked proliferation of the connective tissue, which forms tufts upon

the inner surface of the tumor. These branching projections may distend the sac to bursting; the tufts project upon the outside, and lead to rapid infection of the general peritoneum. Vegetations spring up luxuriously over the surface of the ovary, and are carried to every part of the peritoneal cavity, and not infrequently by aspiration are made to penetrate the diaphragm into the thorax. The contact of the peritoneum with the infection produces extensive ascites. Similar vegetations may arise spontaneously upon the surface of the ovary, and are then known as superficial papillary. These are cases in which a small cyst is opened and infects the external surfaces. Papillary tumors rarely attain a large size, but are generally bilateral. The dendritic growths project in every direction. The projections are reddish or pearly white and glistening, often three or four inches long, and have the appearance of stems of coral. Masses occasionally undergo partial calcification; so they break easily and without bleeding.

DERMOID CYSTS.—These are growths in which are found skin and mucous membrane, with all the structures generally associated with such tissues. The tissues most frequently found are teeth, hair, nails, and sebaceous and sweat glands. Other structures occasionally seen are *mammæ*, horn, bone, unstriped muscular fiber, and very rarely tissue resembling brain. Fat or sebaceous material at the temperature of the body is generally in a liquid state. Occasionally they are found in solid balls. Sutton reports finding three hundred of these in one sac. In one patient on whom I operated the fluid was filled with

masses of sebaceous material the size and shape of peas. Hair is frequently present in great abundance, and varies in color, length, and quantity. It may be blond, brown, or black, but bears no relation to the color of the individual. Teeth are found in about one-half the cases, and may be loose, fixed, or buried in the wall. All varieties of teeth are found. Schnabel describes a cyst which contained three pieces of bone and one hundred teeth. Plouquet found three hundred teeth. Various bones have been described, as the jaw, petrous portion of the temple, ribs, and pelvic bones, a finger with articulated phalanges, nail and nail-fold, or entire skeleton has been recognized. Dermoids do not always occur alone, but in conjunction with large glandular cysts, the dermoid forming a small part of the mass.

TERATOMA.—This is a more complete form of growth of tumor which is usually classed with the dermoid. It often attains to an enormous size, contains the various structures of the dermoids, cartilage, and a large amount of connective tissue. Dermoid growths can appear at any age, have been found in children at birth, and in women of 90 years. The contents of the dermoid sac are exceedingly irritating, and every precaution should be practised to prevent their escape into the peritoneal cavity.

PAROVARIAN CYSTS.—The parovarium, or epoöphoron, is situated in the lateral part of the mesosalpinx and is a remnant of the Wolffian body. Parovarian tumors are almost always cystic and subserous, and consequently have a double wall. The external peritoneal

is easily separable. The pedicle consists of the tube, median ovarian ligament, and the suspensory ligament. Paroöphoron and broad-ligament cysts form about 11 per cent. of abdominal tumors of pelvic origin, and both proliferating and dermoid growths have been found in this situation. They are distinguished from ovarian, first, by the ease with which the peritoneum can be stripped off; second, by the ovary being generally found attached to the side of the cyst; third, by the cyst being unilocular; fourth, by the Fallopian tube stretching over the cyst, never communicating with it; lastly, the gradual thickening of the mesosalpinx.

Solid growths of the ovary comprise 5 per cent. of the cases presenting themselves for operation. These tumors are benign or malignant, and may become cystic.

FIBROMYOMA.—This is a benign form of rare tumor, but the most common species of solid ovarian tumor. The growth is slow and maintains the normal shape of the ovary. Adhesions are rare. Williams described one which weighed seven pounds, seven ounces; Doran, one of seventeen pounds.

Out of 488 cases of ovarian tumor, 439 were cystic and 49 solid tumors. The 439 cystic showed: adenocystomata, 284; dermoid, 44; broad-ligament cysts, 36; papillomata, 24; carcinomata, 50; perithelioma (sarcoma), 1. H. Briggs and T. E. Walker (Jour. of Obstet. and Gynec. of Brit. Empire, Feb., 1908).

SARCOMA OF THE OVARY.—This resembles in form, size, and color a fibroid, excepting that its surface is smoother; its consistence is softer than a fibroid, though it contains much fibrous tissue, making the diagnosis at times difficult to determine. It occurs in the round and spindle-cell growths.

The latter predominating, the tumor is more solid and more strongly resembles the fibroid. Spindle and round cells are frequently combined, while myxomatous transformation exists in both kinds, but cartilage- and bone-formation rarely occurs. Sarcoma combined with carcinoma has been observed in the walls of larger cysts.

CARCINOMA OF THE OVARY.

—This occurs much more frequently than is suspected. Both the glandular and the papillary are frequently complicated by manifestations of malignancy which are not recognized unless careful macroscopic or microscopic investigation is made of the structure of the growth. The medullary formation is the more common, and may form a tumor quite as large as a man's head.

Cancer of the ovary in a girl aged 11 years. Accurate diagnosis of malignant tumors of the ovary in young girls is rarely possible. An **exploratory laparotomy** should be made whenever fluid is found in the abdomen of children without general anasarca, provided adhesive pericarditis and cirrhosis of the liver be excluded. The **removal** of ovarian tumors in young girls should not be delayed. Metastatic nodules in the fossa of Douglas or elsewhere, if definitely made out, contraindicate operation. Lahey and Haythorn (Amer. Jour. Med. Sci., Feb., 1912).

In 111 of the operative cases of cancer of the ovary, single **ovariotomy** gave a mortality of 24.5 per cent. in 49 cases; double ovariectomy, 22.22 per cent. in 27 cases, while **hysterectomy** gave only 9.09 per cent. mortality. The patient that died generally succumbed to operative shock. Of the 89 who survived the operation, the fate of 59 is known, and all but 11 have died of recurrence. It seems necessary to **remove** the **lymph-nodes** in the **lumbar region**, as they are

generally involved. G. Massabuau and E. Etienne (*Revue de gynéc.*, xx, No. 3, 1913).

In 23 cases of malignant ovarian disease treated with **X-rays**, over $\frac{1}{2}$ were materially benefited, with no recurrence after 1 year in 1 case, and after 3 years in 2 cases. In 3 cases the cancer was a metastasis of a mammary cancer. One of the much improved patients was a woman of 24 with a sarcoma in the knee and neck, both of which rapidly retrogressed under **X-rays**. Two months later a sarcoma developed in the ovary, which was not modified by **X-ray** exposures or arsenic. Later the ovary was removed and injections of the **woman's own ascitic fluid** were given. These induced a febrile reaction with pain in the lower abdomen, neck and knee. Since then she has been well. Orbaan (*Nederl. Tijdsch. v. Geneesk.*, Aug. 21, 1920).

SYMPTOMS OF OVARIAN TUMORS.—Early stages of ovarian tumors produce no symptoms. Occasionally an apple-sized tumor, though movable, may cause unpleasant symptoms, as pain in the sacrum, which extends down the leg. Intraligamentary tumors, or those prevented by adhesions from rising out of the pelvis, produce severe symptoms as soon as they fill the space, especially by obstruction to stool and micturition. In large tumors distress arises from pressure, and interference with the circulation and respiration. The skin becomes stretched and forms striae, swelling of the navel, hernia, occasionally from pressure upon the great vessels, edema, varicosities in the legs, in the sexual apparatus, and in the skin of the abdomen. Albuminuria, diminution of the urine, and compression of the renal veins are observed. Severe compression symptoms are now rarely seen from large

tumors, as they are generally subjected to early operation. Menstruation is usually unaffected. It disappears comparatively early in those cases in which the follicles perish from the development of sarcoma, carcinoma, and the papillary cystadenoma when bilateral. Menstruation decreases, and the disposition to menopause is betrayed, not from absent ovulation, but as a result of constitutional conditions. Amenorrhea may exist for several years and menstruation return after the removal of an ovarian cyst.

DIAGNOSIS OF OVARIAN TUMORS.—Diagnosis of ovarian tumors is mainly secured by physical signs. The questions to be considered are: First, does the patient under consideration have a tumor? Second, the existence of a tumor recognized, is it an ovarian growth? Third, an ovarian tumor admitted, what are its relations to the surrounding parts? Does it have a pedicle or are there adhesions? Fourth, what is the variety of ovarian tumor? For convenience of diagnosis ovarian growths are divided into two classes: those small, and situated within the pelvis, and the large, or those which rest upon its brim. The abdominal enlargements other than tumors with which an ovarian growth may be confused are: obesity, desmoid tumor of the abdominal walls, ventral hernia, tympanites, fecal accumulation, distended bladder, and ascites.

Alternating, periodical swellings or tumors of the ovary which may be the size of a fist or goose egg may occur. Such patients are sometimes rushed to the hospital where during examination the "tumor" disappears. There may be found a little bloody serum but the tubes and uterus are normal. Or, the menstruation may

come late and persist. A cyst of the corpus luteum may be found, or tumor of the right appendages. After menstruation, the tumor disappears. In one instance the patient came 20 times for examination. In this case the eventual operation revealed extensive adhesions of the appendix and other structures with enlargement of both ovaries. Recovery resulted. But operation is not always necessary; in one instance the cyst burst, with cessation of pain and no untoward results. Ries (Trans. Amer. Med. Assoc.; N. Y. Med. Jour., June 21, 1919).

In *obesity* the history of development, the general distribution of adipose, and the thickness of fat-accumulation in the abdominal wall should be contrasted with the general emaciation which characterizes a large ovarian cyst.

Desmoid tumor of the abdominal wall occurs in the muscle wall, simulating an intra-abdominal fibroid. From its weight, it becomes very dependent; sometimes extends to the knees; is quite movable, very superficial, and hard. Its situation in the wall, its density, and failure to recognize by vaginal or rectal examination any connection with the pelvic viscera should determine its character.

Occasionally such growths spring from the under surface of the abdominal muscles, grow inward pushing the peritoneum before them. I removed one weighing nineteen pounds, which I only recognized as a desmoid when attempting its removal. A careful pelvic examination would have disclosed that it had no connection with the uterus and its appendages.

Ventral Hernia.—The recognition of the coils of intestine, and peristaltic action, through the thin wall, is sufficient.

Tympanites or phantom tumors, a condition similar to pseudocyesis, is sometimes mistaken for ovarian cyst. A loud volume of resonance is easily recognized, and differentiates it from a cyst. It is true that occasionally a cyst may have communication with the intestine, which will permit gas to enter it and thus afford resonance. Even in these cases a sensation of fluctuation is secured which is absent in the phantom tumor. The latter tumor entirely disappears when the patient is placed under an anesthetic.

Fecal accumulation occurs in the colon or transverse portion of the gut, which may descend and lie directly over the pelvis. The accumulations are occasionally quite extensive, but are recognized by their length, by the peculiar sensation under palpation, leaving an imprint under pressure; most of all, by the fact that they disappear with purgatives and enemata.

Distended bladder causes symptoms of a tumor in the lower part of the abdomen, which fluctuates, and may readily be mistaken for an ovarian cyst. The suspicion is apparently confirmed by the history that the patient is passing urine in small quantities or that it is continually dribbling. This, however, should at once cause a suspicion of retention of urine and the introduction of a catheter by which the tumor is dispersed.

Ascites.—With uncomplicated ovarian cysts diagnosis from ascites is not difficult. They have in common enlargement of the abdomen, fluctuation, and symptoms arising from pressure against the diaphragm. Both may be characterized by progressive loss of strength and flesh, more or

less edema of other parts of the body, and an enlarged abdomen. In ascites the abdomen is more or less flattened, its widest diameter transverse, while an ovarian cyst is most prominent in the vertical diameter, and narrow from side to side. Fluctuation over the abdomen is very distinct in ascites and in unilocular ovarian cyst, but its wave extends nearer to the vertebræ in ascites. In the well-filled cyst the projection of the vertebræ prevents the approach of the fluid in the lumbar region. In multilocular cyst the wave is more broken and frequently is only recognized as a sensation of elasticity. Loss of strength is frequently greater in ascites, while emaciation is more marked in ovarian cyst. In renal and cardiac disease there is a greater disposition to anasarca.

In very advanced and quite large ovarian tumors pressure may exist, and considerable dropsy of the extremities, but the abdominal distention is in greater proportion. On palpation, ovarian tumor presents greater resistance, and the outline of the surface is more distinctly determined. The abdominal surface can be moved over it. Percussion affords the most valuable information. In ascites is a distinct zone of resonance over the abdomen or part of greatest prominence, while the more dependent portions are dull. The zone of resonance changes with the position of the patient; in ovarian cyst, on the contrary, there is dullness upon percussion over the whole surface of the tumor—resonance only after we have passed beyond its limits, and the line of resonance does not change with the position of the patient. In tubercular peritonitis and in hepatic

dropsy, where the mesentery has undergone contraction and the peritoneum is very much thickened, diagnosis can be so obscure as to require abdominal incision to determine it. Ascites may complicate an ovarian cyst. By displacement of a layer of fluid the hand will come in contact with the cyst. The amount of resistance will afford information as to whether the tumor is solid or cystic. Complication of a cyst by ascites should awaken suspicion of malignancy or some degenerative process. The greater the amount of ascites, the more probably the growth is malignant. Torsion of the pedicle and death of the cyst will cause extensive ascites. The uterus is freely movable in ascites and an ovarian cyst will be displaced either downward and backward or upward and forward. In ascites arising from rupture of a papillary cyst the recognition of a dense, thickened mass upon either side of the uterus should cause a suspicion of its true character.

Ascitic fluid always contains fibrinogen, which is precipitated by common salt, whereas this is never found in the contents of ovarian cysts. If, therefore, a small quantity of the fluid removed at the tapping is placed in a test-tube, and one-third its volume of salt added, a flocculent precipitate will form on standing, after the salt has dissolved, if the fluid is ascitic in origin. If no precipitate forms, the fluid is certainly not ascitic, and exploratory operation should be insisted on. This test has a distinct field of usefulness, for in not a few cases of ovarian cyst the contained fluid presents all the appearances of that from an ascites, and *vice versâ*, in some cases of ascites with admixture of chyle the fluid may strongly suggest rather thin cyst-contents. Dienst (Münch. med. Woch., lix, 2731, 1912).

Second, is the tumor under observation an ovarian growth? The physical signs vary with the size and situation of the tumor. In its early stage it is entirely within the pelvis, and its position varies. When as large as a hen's egg it falls into the pelvis, where it remains until it attains a size which will no longer permit its accommodation in that situation. Its relation with the corresponding side of the uterus permits its determination by conjoined manipulation. Where the condition has been complicated by peritonitis, the diagnosis may be difficult. Fluctuation or even elasticity does not characterize the smaller growths. It is absent entirely in proliferating cystomata, in dermoids, and often even in single cysts. If we are unable to separate the tumor from the uterus and determine the existence of a pedicle, it can be accomplished by seizing the uterus with a vulsellum while the patient lies upon her back, and with two fingers in the rectum differentiate the borders of the uterus and the relation of the latter to the growth. In small growths the hand over the abdomen and finger in the rectum will generally enable us to outline them. Fibroid tumors of the uterus and inflammatory growths of the tubes are likely to be confounded with small ovarian cysts. Tubal growths are pyosalpinx, hydrosalpinx, and hematosalpinx, the characteristics of which we have already discussed. In *pyosalpinx* the acute history, marked tenderness, existence of inflammatory exudation, and the matting together of the pelvic tissues should distinguish it. A *hydrosalpinx* is generally movable, gives a sensation of elasticity or of fluctuation, but the tumor

is oblong and gourd-like, rather than spherical. A *hematosalpinx* is situated to one side of the uterus, is at first soft, but becomes harder from the coagulation of blood. In the large abdominal growths an ovarian cyst distends the abdomen, particularly at its lower part, rises abruptly from the pubes, and is sharply defined and symmetrically developed. In large single cysts the surface will be smooth and regular, but, in the multilocular, projections and irregularities are found. When made up of a large number of small cysts, it will be more resistant, although it will still present a sensation of elasticity.

Large growths are confounded with pregnancy, hydramnios, extra-uterine gestation, uterine myomata, retroperitoneal growths, and tumors of the various viscera of the abdominal cavity.

Pregnancy.—The enlargement of the abdomen is more rapid, is generally associated with suppression of menses, and the presence of sympathetic nervous phenomena, while in the more advanced stage the patient presents a florid, healthy appearance. Errors are more likely to occur in the unmarried during the early stage of pregnancy. The physician should not be hasty in expressing an opinion, so long as there is any reason for doubt. An examination a few weeks later will dispel uncertainty. As pregnancy advances, fetal movements, heart sounds, and parts of the fetus are recognized. Fetal heart sounds, when heard, are characteristic. Gestation in one horn of a bicornate uterus will make the diagnosis difficult, but a careful bimanual examination will demonstrate the association of the enlargement with

the uterus. Under no circumstances should the length of a uterus be determined by the sound, when there is the least suspicion of pregnancy.

Pregnancy frequently takes place in the presence of ovarian tumors, even though both ovaries be involved. Induced abortion with its 100 per cent. of child mortality is unjustifiable. **Removal of the tumor** as soon as possible after its discovery gives a high percentage of good results in both mother and child. Barrett (Surg. Gynec. and Obstet., Jan., 1913).

Hydramnios is a pathological form of pregnancy in which a large collection of amniotic fluid occurs in the uterine cavity. When the collection exceeds two quarts upon examination for ovarian cyst, the history is of value. *Hydramnios* comes on suddenly, occurs about the sixth or seventh months of a pregnancy which has previously run a normal course. The physical examination will disclose an enlarged uterus, cervix frequently obliterated, os open, covered with a dense membrane through which, by manipulation, we may distinguish the parts of the fetus or determine *ballottement*.

Extra-uterine Pregnancy.—An ectopic gestation sufficiently large to permit it to be confounded with an ovarian cyst will present the symptoms of an early pregnancy, possibly indications of rupture of the sac and internal hemorrhage. In advanced stages fetal movements and heart sounds will be heard. Vaginal palpation discloses the fetal parts covered with a thin wall. After death of the fetus changes will occur which render the diagnosis more difficult. The fetus shrinks, becomes macerated, decomposition in the sac occurs,

which renders it resonant, while at the same time fluctuation is distinct. The diagnosis is determined by careful analysis of the subjective symptoms, associated with a thorough physical examination.

Nélaton in 1850 described retro-uterine hematocoele and in 1873 Gallard emphasized the importance of ectopic gestation as its cause. Since the latter date gynecologists have properly looked upon free pelvic hemorrhage as evidence of ectopic gestation. As an exception to this general rule, however, a recent case of the author's presented severe pelvic hemorrhage with the origin in a ruptured follicular cyst of the ovary. E. Novak (Jour. Amer. Med. Assoc., lxxviii, 1160, 1917).

Uterine Myomata.—Slow growth, resistance of the tumor, presence of multiple growths, irregular contour, and relation to the uterus afford confirmation in the diagnosis. The difficulty may be as great in edematous fibroids and in fibrocystic tumors. Double ovarian cysts, particularly where the pedicle is short or absent, may so drag up the fundus uteri as to make it appear that they are a part of the organ itself. The relation of the uterus to the tumor is best determined by drawing down upon the cervix with a vulsellum, which is held by an assistant, while a second assistant draws up the tumor through the abdominal walls and simultaneously the operator with one or two fingers in the rectum, the hand over the abdomen, seeks the pedicle and determines its relation to the uterus.

Third, the relation of the tumor to the surrounding parts, the character of the pedicle, and the presence of adhesions. The mobility of the tumor is dependent upon the length of its pedicle and the absence of adhesions.

The tumor which can be pushed about without dragging upon the uterus and can be displaced from side to side, the abdominal wall sliding over it, is recognized as free from adhesions and having a long pedicle. Rapid enlargement, tenderness of the abdomen, sensation of crepitus as the abdominal wall is moved over the tumor, indicate recent and extensive adhesions from peritonitis. Limited adhesions of the omentum, intestine, and abdominal wall cannot be excluded.

Torsion of the pedicle is recognized by the onset of sudden and severe peritoneal symptoms, severe pain in the belly, meteorism, vomiting, rapid pulse, and some fever. Rapid growth of the tumor and tenderness of its surface indicate that torsion has been followed by intracystic hemorrhage or increased exudation. Sudden collapse followed by symptoms of internal hemorrhage and peritoneal irritation indicates the occurrence of hemorrhage. Acute torsion is difficult to differentiate from rupture of an ovarian cyst, and peritonitis from perforation of the stomach or intestines, renal or gallstone colic, ileus, and rupture of ectopic gestation. We can only arrive at a conclusion from careful investigation of the history.

Inflammation of the tumor is characterized by sensitiveness, radiating pain; sudden enlargement and supuration may lead to formation of gas and development of tympanitic resonance.

Rupture of a cyst is recognized by sudden oppression, suffocation, nausea, sometimes vomiting, diarrhea, acceleration of the pulse, moderate elevation of temperature, presence of

free fluid in the peritoneal cavity, and indication of decrease in the size of the tumor, with strong diuresis. Tumor limits are indistinct and there is no alteration of resonance with the change of position.

DIAGNOSIS AS TO VARIETIES OF OVARIAN TUMOR.—The glandular proliferating cyst is the most frequent, and attains the largest size. They are mostly multilocular, and consequently present a less-marked wave of fluctuation. Fluctuation is an indication of its cystic character and is very distinct in the unilocular and large-chambered cysts. Instead of fluctuation we not infrequently find elastic stretching which can be produced by edematous, solid growths, and enlarged cysts whose contents are made up of colloid or very thick, viscid material. In fluctuating or tough, elastic tumors which are nodular we find a cystadenoma. A large fluctuating tumor is not necessarily a unilocular cyst; generally a small cyst which causes no symptoms is not a cystadenoma, but a dermoid or parovarian, or, more probable still, a simple retention cyst of the ovary.

Dermoid tumors are recognized by their irregular consistency, in some places soft and in others hard. The recognition that the tumor has been in existence for ten years or more will indicate a probable dermoid. Olshausen differentiates parovarian growths by their moderate size, slow growth; thin, relaxed walls; light fluid contents, and very distinct fluctuation. Large cysts are generally multilocular.

Double intraligamentary growths and the presence of ascites with small tumors is a presumption of papillary

growths, but not a positive indication. Superficial papillomata feel firm, nodular, and often extend diffusely into the pelvis. A rapidly developing ascites in which renal, cardiac, and hepatic causes can be excluded, should, in the presence of bilateral resistance, awaken a suspicion of ruptured papillary ovarian cyst. Pronounced solid consistence of a growth is common to ovarian fibroid, sarcoma, endothelioma, carcinoma, and teratoma. An ascitic accumulation as a complication is a presumption of malignant trouble. Pronounced cachexia and marasmus may be produced by certain complications, as rupture, torsion, inflammation, also in tumors of normal size. Rapid growth especially speaks for malignancy. Olshausen directs attention to premature edema of the legs as a symptom of cancer.

ETIOLOGY.—Various theories have been advanced as a cause for the development of ovarian tumors. Cohnheim believed them to originate from retained embryonic products. It was formerly supposed that the dermoid was thus derived, but the diversity of structure found in the dermoid, and especially in the teratoma, precludes the possibility of such origin and favors the assertion that they arise from ovum cells which have been subjected to some special irritation. The variety of irritation, whether mechanical or chemical, animate or inanimate, differs in various kinds of tumors, and is as yet unknown. It is probable that it is chemical irritation which has proceeded by way of the uterus and tubes. Susceptibility for the acceptance of the tumor excitors varies in different individuals, in which the

heredity, acquired disposition, age, trauma, scar formation, and inflammation are important factors. Age has no special significance, though glandular cysts are more frequent between the thirtieth and fiftieth years. All varieties are less frequent in childhood and old age. Ovarian growths are more frequent in the single than in the married.

COURSE.—Proliferating cysts grow more rapidly than either the dermoid or solid tumors unless the latter are malignant. A rapid increase in the size of a growth noticeable from day to day is due to hemorrhage. When the pelvic structures are normal, an enlarged cystic ovary will drop by its weight into Douglas's pouch. As it increases in size, it advances in the direction of least resistance, which is upward, and pushes before it the intestines, when it will rise out of the pelvis and impinge against the abdominal wall. It then assumes a central position. The tumor lies directly above the uterus, rests on the brim of the pelvis, and causes but little inconvenience. Occasionally it may become impacted, because of irregularities in its growth or from extensive adhesions. The tumor rests upon the pelvis; as it advances it pushes the intestines upward and laterally. If undisturbed, the enlargement becomes so great that the diaphragm is pushed upward, severe pressure symptoms follow, and the action of the heart and lungs is obstructed. Marked suffering, emaciation, and the development of the characteristic facial expression known as *facies ovariana* follow. The presence of ovarian tumors does not interfere with ovulation and menstruation, even though both ovaries

are involved, so long as ovarian stroma remains. Thornton reports a case of pregnancy with bilateral dermoid disease.

COMPLICATIONS.—Among the complications of ovarian tumors, ascites occurs infrequently with cystic growths, unless from rupture, but is very frequent in the solid. The cause is unknown; it may possibly arise from pressure upon the vena cava or large veins. The edema may enlarge one or both legs. The ureter and pelvis of the kidney may be dilated.

The most frequent complication is the formation of adhesions between the surface of the tumor, the omentum, the intestines, the uterus, the bladder, and the abdominal wall. These adhesions arise from inflammation, as in peritonitis. When not associated with inflammation they arise from loss of epithelium from the surface of the cyst, through friction. Adhesions may become dense, firm, often thread-like, and may convey large vessels between the omentum and growth. Adhesions are frequent in dermoid growths. When adhesions exist between the tumor and bladder, an opening may occur through which its contents are evacuated; openings also occur between the tumor and bowel. Adhesions are of importance because of the increased difficulty in the removal of the growth.

Torsion of the pedicle is a quite frequent complication. It is only when the alteration is sufficient to influence the circulation that it produces disturbance. The right-sided tumor turns to the left and the left-sided to the right. The cause of the torsion is unknown. Küstner as-

cribes it to peristalsis and the varying distention of the rectum; Carrio, to sudden belly pressure; Mickwitz, to contraction of the transversalis muscle. It is very frequent when associated with pregnancy; may occur also from injury. The twist may involve one or two turns of the pedicle, though as many as six twists have been observed. The tendency to torsion of the pedicle is favored by the existence of a long, membranous pedicle, spherical form of the tumor; still further by pregnancy, labor, and childbirth, through the changing relations of the organ in the abdominal cavity. Torsion is the cause of obstruction of the vessels, in which the thin-walled veins suffer before the more resisting arteries. The pumping of blood into the tumor by the artery and its inability to escape by the vein give rise to rapid increase in the size of the tumor. Fatal result can occur from hemorrhage into the abdominal cavity. Hemorrhage may be arrested, but the nutrition of the tumor suffers; its covering epithelium is lost; extensive adhesions follow between its surface and the omentum, intestines, and parietal peritoneum. Adhesions at first are very loose, subsequently becoming organized. The growth thereby obtains a new source of nutrition. Where the twisting of the pedicle is sufficient to obstruct the arteries, the entire circulation is cut off and necrosis of the growth results. Necrosis is followed by shrinking of the tumor and absorption of its fatty contents; peritonitis may follow, and extensive ascites exist. Peritonitis arising independently of micro-organisms is due to irritation from the presence of a foreign body or the chemical products of the tumor.

Sometimes suppuration of the tumor and pyemia ensue.

Dermoid growths are occasionally found free in the abdominal cavity or in pedicle-like adhesion with other structures. Ileus has resulted from adhesions of the intestines to the tumor or to the pedicle. Torsion infrequently may produce no symptoms. These are usually slight, and can be suspected when the patient suffers a severe pain associated with meteorism, sensibility to pressure, acceleration of the pulse, sometimes singultus, vomiting, and fever.

Inflammation and suppuration of the cyst is a complication which may occur, though much less frequently than formerly, when puncture of the cyst was often practised. Infection may extend by the uterus and tube, or by intestine, particularly where adhesions occur between the latter and the sac. Dermoid tumors are inclined to suppurate, probably as a result of injuries which they undergo during their long presence in the body. The occurrence of inflammation and suppuration is indicated by fever, which varies in intensity according to the extent of infection. The patient experiences but little pain, unless peritonitis is associated. Adhesions to the suppurating tumor may occur and the pus make its exit to the bladder, rectum, or vagina. It is rarely that it is completely evacuated and spontaneous recovery follows. Death usually occurs from pyemia. Rupture into the peritoneal cavity is rapidly followed by fatal peritonitis. Such a tumor opening into the bladder produces the greatest distress, as hair, teeth, and pieces of bone are thus discharged; sloughs are impacted in the urethra, inducing cys-

titis, retention of urine, and marked vesical tenesmus. Fragments, when retained in the bladder and coated over with salts, form the nuclei of calculi.

Rupture of Cystic Tumors.—The rupture may occur suddenly as a result of a fall or blow, or gradually from changes in the cyst wall. In papillary growths the pressure of the vegetation causes thinning of the cyst wall, and finally rupture, or the growths extend through the wall of the cyst and on its external surface. Rupture of the cyst can occur into the surrounding viscera, but more frequently into the peritoneal cavity; in a thin-walled cyst it occurs easily, under manipulation to determine the diagnosis, change of position in bed, the act of coition, or vomiting, and occasionally occurs without assignable cause. The effect of the accident will depend upon the character of the cyst contents. In unilocular cysts no untoward symptom occurs beyond excessive flow of pale urine. In single parovarian cysts recovery may follow the rupture. Generally, however, the opening closes and the fluid reaccumulates. In rare cases it is followed by high temperature, rapid pulse, vomiting, pressure at stool, and diarrhea, which indicate the condition of the contents: a kind of autointoxication. In multilocular and dermoid growths rupture into the peritoneal cavity is often followed by infection, rapidly developing peritonitis, and finally death. Rupture of papillary cysts results in infection of the peritoneum and the formation of ascites. Vegetations spring up over the entire cavity. Sometimes an artery is torn in the rupture, and marked hemorrhage with profound anemia follows.

The occurrence of rupture is recognized by disappearance of the tumor, diminution of its size, recognition of free fluid in the peritoneal cavity, peritonitis, collapse, diarrhea, and diuresis.

Ovarian tumor may be complicated with **pregnancy**. It is more frequent in the one-sided, though it may occur in the double-sided ovarian tumor. It can occur with any variety of tumor, though more likely to complicate the slow-growing formations. Numerous cases are recorded where the person carrying an ovarian tumor has run successfully the gauntlet of several pregnancies. The ovarian tumor does not grow so rapidly in pregnancy as does the fibroid. The occurrence of pregnancy will depend upon the size of the tumor. Very large tumors may, with increased size from pregnancy, cause marked dyspnea, requiring interference. The influence upon the labor will depend upon the situation of the growth. The very large growths interfere with uterine contraction, and especially the voluntary assistance. If the tumor rests above the uterus and presses it down in a position of retroversion, or retroflexion, it may cause impaction and finally abortion. A tumor situated in the pelvis below the uterus interferes with delivery, and unless it can be displaced its size must be reduced. The passage of the child over the sac of an emptied ovarian cyst may cause such severe traumatism of the latter as to occasion subsequent inflammation and infection.

Degenerative Changes in the Cyst Walls.—The cyst walls can undergo the following degenerative processes: First, calcification; second, fatty degeneration; third, atheroma-

tous changes; fourth, changes due to infarctions.

TREATMENT.—No other treatment is now recognized as worthy of consideration in the treatment of ovarian cysts than their **extirpation**. Puncture or paracentesis was formerly an accepted procedure, but experience has disclosed that it is attended with danger. It is but palliative, and presents the possibility of puncture of a large vessel in the tumor wall, with consequent hemorrhage; infection of the peritoneal cavity by escape of the contents of a papillary cyst or colloid material and infection within the cyst, followed by inflammation and suppuration, are possibilities which should preclude the practice of this procedure.

Ovariectomy.—Extirpation of the tumor is known as ovariectomy or, better, **cystectomy**. Success in its performance will depend upon the care with which the diagnosis has been made, the knowledge the operator has as to the condition of his patient, his dexterity in the performance of the operation, and judicious treatment subsequently.

Results of conservative surgery of the ovaries in 131 intelligent women from private practice. All the operations were done more than six months before, this time-limit having been chosen because symptoms of the surgical menopause generally develop within this time if at all. In 80 per cent. of the cases in which one or both ovaries were left, no climacteric disturbances of any kind occurred. The failure to prevent these entirely in the remaining fifth of the cases may have been due to lack of skill or care in preserving the ovarian circulation. This is better accomplished by leaving the tubes as well, when they are healthy, as important nerves and arteries going to the

ovary may be cut in removing them. All healthy ovaries should be left in place, even if the patient is near the menopause, since no one can say just what is the term of ovarian activity, and especially is this true in fibroid cases, in which the ovary is notoriously long-lived. Dickinson (*Surg., Gynec., and Obstet.*, xiv, 134, 1912).

Except in malignant disease, double ovarian abscess, and tuberculosis, it is practically never necessary to remove both ovaries from a woman of active menstrual life. Ovaries that reach the size of an English walnut and contain cystic bodies should, however, not be regarded as normal. In so-called cystic ovaries, the writer **resects** and **punctures** the small **Graafian follicle cysts**, even splitting the ovary down to the hilum in order to discover small cysts that are concealed. Out of 110 cases treated in the last fourteen months 106 were traced; in 87 (82 per cent.) the results of the operation as stated were satisfactory. On the other hand, the conservative operations are not followed by lasting ill-effects. Reynolds (*Amer. Jour. of Surg.*, May, 1912).

Routine conservation without due consideration of ovarian and contiguous pathology is not good teaching. Regeneration of the conserved ovary depends largely on the type and duration of the existing infection and the condition of the tunica of the individual ovary. Even where the most detailed technique is observed the ovarian circulation is impaired. The retained ovary without the uterus is always a focus for possible trouble. The life history of the retained ovary is of short duration and the trophic influence of the diseased ovary has been overestimated. Finally, a cured patient has few nervous symptoms. J. O. Polak (*Trans. Amer. Gyn. Soc.; Med. Record*, Oct. 19, 1918).

Indications.—It was formerly a rule that patients should not be subjected to an operation until the tumor attained to such size that the woman

was beginning to suffer inconvenience from the distention. The introduction of the principles of antiseptics and asepsis has rendered such postponement unnecessary.

Details of 292 ovariectomies during pregnancy, 11 of his own. Abortion followed in 42 out of a total of 227 cases, that is, in 15.1 per cent., but in many of these the abortion was the result of other causes rather than of the **ovariotomy**, as, for instance, when the ovary was found cancerous or the seat of dermoid cysts, which seem to exert a specially unfavorable influence on the fetus and peritoneum. Unusually numerous and solid adhesions were encountered in a number of the cases. Omission of these leaves a percentage of abortion in only 10.3 per cent. of the total 277 cases, while the average of abortions under expectant treatment of ovarian neoplasms is about 17 per cent. The month of the pregnancy does not seem to affect the percentage of abortions. Flatau (*Archiv f. Gynäk.*, lxxxii, F. v. Winckel Nu., 1907).

The large proportion of tumors in which malignant complications are found, the danger from injury of the growth and torsion of its pedicle, indicate the necessity for early operation.

The tendency of ovarian tumors is almost always to increase in size more or less and also, sooner or later, to undergo torsion, hemorrhage, gangrene, infection, or malignant degeneration. Hence in general, these cysts should be **removed** as soon as possible after they are discovered. One should be particularly careful not to let a woman pass into puerperium without first ridding her of the cyst. W. C. Jones (*Surg., Gynec., and Obstet.*, Jan., 1913).

Technique.—The operation consists in: First, the incision of the abdominal wall; second, puncture of the cyst and separation of adhesions;

third, ligation of the pedicle and removal of the cyst; fourth, exploration of the remaining ovary and toilet of the peritoneum; fifth, drainage; sixth, closure of the wound; seventh, dressing. The abdominal incision is made in the median line about three inches in length midway between the umbilicus and symphysis. Incision is made through skin, superficial fascia aponeurosis, and deep fascia to the peritoneum. It is generally aimed to make this incision through the linea alba, but in undilated abdominal walls the separation between the muscles may be so slight as to render it difficult. The sheath of the rectus muscle is opened from the side; the incision should extend through the muscle, as its injury is immaterial. Bleeding vessels are secured; the peritoneum is then picked up and incised between forceps so as to avoid injuring the sac or a knuckle of intestine which may be situated in front of it. With the completion of the incision, the pearly-white sac is exposed. It may be explored by introducing the hand, passing it around the tumor, thus recognizing the presence or absence of adhesions. With an assistant pressing the sac firmly against the wall, a trocar to which a long rubber tube is attached may be plunged into the tumor and the fluid carried into a vessel at the side of the table. In the absence of the trocar an ordinary glass-syringe nozzle can be utilized. Incision is made with the knife into the tumor wall and then the syringe nozzle introduced. In a properly arranged clinic room no trocar need be employed; the cyst is punctured with a knife while the assistant keeps the abdomen tense, the edges of the incision are seized

with hemostats and drawn out, making the cyst walls serve as a funnel to preserve the peritoneum from soiling by the tumor contents. The assistant presses the tumor down against the abdominal wall, and keeps it tense. As the fluid is discharged the sac becomes relaxed. As the sac is drawn out, the adhesions are separated; those which are recent and soft may be overcome by pressing against them with a sponge or gauze pad. In this way the adherent intestines are sponged away from the cyst. Where the adhesions are old and firm, they may require scissors or knife to accomplish their separation. Bleeding vessels in these adhesions should be secured with hemostat or immediately ligated. Where the adhesions are very firm and short, so that the intestine lies directly upon the tumor wall, separation will frequently be attended with marked injury to intestine. To prevent this, a portion of the sac wall should be permitted to remain in contact with the intestine, taking the precaution to strip off from it the secreting surface. The adhesions as far as possible should be separated under the eye, keeping a watch for large vessels and avoiding injury to intestines, and particularly to the spleen and liver. Vascular adhesions in the omentum should be at once secured either by clamp forceps or ligature.

Ligation of the Pedicle and Removal of the Cyst.—Ligation may be accomplished with silk or catgut, preferably the latter. In a long, slender pedicle it is transfixed in the center, ligated in two portions. Thicker, shorter pedicles may be ligated in several sections or the pedicle may cut through, using clamp forceps to

secure it and the vessels be ligated separately. With ligation of the principal vessels clamp forceps are removed and the surfaces carefully observed for further bleeding. If possible all the raw surfaces are covered with peritoneum. Where the pedicle is ligated in sections the sutures should be interlocked to prevent their tearing below, which might cause serious bleeding. In large cysts, for the withdrawal of the cyst the pedicle is seized with clamp forceps and the cyst cut away as a preliminary to the ligation.

Having secured the pedicle the condition of the other ovary is investigated and the toilet of the peritoneum effected. The investigation of the remaining ovary is important for the reason that not infrequently a smaller cyst will necessitate a subsequent operation. Where a cyst of considerable size exists the ovary should be removed. Smaller cysts in the ovarian structure may be resected or the cysts punctured with a thermocautery. Where an ovary can be saved it should be done. The next step is the thorough investigation of the peritoneal cavity, looking over the points at which separation has taken place, in order to make sure that no vessels of large size are bleeding. Instead of spending time, however, in sponging out the blood, the better plan of procedure is to irrigate the cavity with a large quantity of normal salt solution. If there are no bleeding vessels of size, the cavity may be filled up with this fluid and the wound closed. All bleeding vessels, however, should be ligated.

Drainage.—The question of drainage is no longer considered of so great importance. Formerly it was the cus-

tom to drain in the majority of cases; now, in a very slight minority. It is only in those patients in whom there is extensive tearing up of the peritoneum, with the probability of oozing or serous effusion, that the operator would consider drainage necessary.

The glass tube was formerly the principal method of drainage; now it is rarely used. It required confinement of the patient to one position, not infrequently injured the intestine by pressure, and afforded ready access to the cavity for micro-organisms. The gauze drain, a split rubber tube or a small roll of rubber tissue are the acceptable methods of drainage. The gauze serves a double purpose, that of a pressure tampon and drainage, and where it can be conveniently done should have an end brought into the vagina and permit the abdominal wound to be closed. Drainage is favored by placing the patient in a semisitting position as favored by Fowler, and the elimination of infectious products promoted by continuous rectal instillation of normal salt solution, known as the Murphy treatment.

Closure of the Wound.—The principle of closing the wound is to bring and retain the various parts of the wound in their normal relation. This is effectively accomplished by employing both interrupted and continuous suture, introducing a continuous suture with catgut to close the peritoneum, then introducing a series of interrupted silkworm-gut sutures which shall pass through the abdominal walls, and pick up the edge of the peritoneum. The placing of these sutures is followed by a continuous catgut suture uniting the aponeurosis of the wall. The tying of the

interrupted sutures holds the surfaces in apposition, prevents the accumulation of fluid in any dead space, and permits the sutures to be tied only sufficiently tight to hold the surfaces in apposition.

Dressing.—The wound should be washed free from blood and alcohol, dried with sterile gauze, and dressed with several layers of the latter covered with a cotton and gauze pad, held in place by tapes attached to pieces of plaster which are placed on either side of the abdomen. Finally the dressing is maintained in place by a good fitting binder.

Fully 5 per cent. of ovarian carcinomas are secondary. The writer has operated on 59 cases of the ovary, in 43 of which but 1 ovary was involved. In 22 of the latter the affected ovary only was removed. The first of these is living, 18 years after the operation. She bore a child 1 year after the operation and is now 45 years of age. While operation should be performed in all cases in which **removal** seems possible, yet in unilateral involvement leaving the second ovary in young women is advisable. If both ovaries are involved, and then only, is removal of the uterus permissible. Hofmeier (*Surg., Gynec., and Obstet.*, ix, 381, 1909).

Method of conservative **resection** of benign ovarian cysts and other tumors which permits retention of a certain amount of ovarian functioning, and thus the women were spared all symptoms of the artificial menopause. Although none of his patients has passed through a pregnancy since, yet he thinks that conception may occur after this method of operating. The writer slits the tumor its entire length by a median incision and thus is able to inspect the ovary completely and detect any scraps of normal tissue still left. If no scraps are found then the operation has to be a complete **ovariectomy**,

but as a rule enough can be discovered in this way and left behind to maintain ovarian functioning in appropriate cases. H. Freund (*Zentralbl. f. Gynäk.*, July 11, 1914).

After-treatment.—The patient is kept quiet in bed, carefully moved from side to side to render her detention less irksome and to lessen the danger of forming adhesions. Until she recovers from the anesthetic, she is given nothing by the mouth other than small quantities of hot water, concentrated beef extracts, and at the end of twenty-four hours, in an ordinary case, may be given a cup of tea and a little soft toast. This is followed later by an egg, chewing some beefsteak, and at the end of the third day ordinary diet.

Vernales found **ergot** useful in warding off symptoms from ovarian insufficiency after ovariectomy, especially the vasomotor disturbances. Denegri has reported fine results from giving in successive 2-day periods **thyroid, pituitary** and **ovarian extracts** in turn; others, from **arsenic** and **mineral waters** containing arsenic and **iron**. The writer ascribes the benefit from these to the regulating action on the thyroid, the latter being always an important factor in the disturbances from loss of the ovaries. Mendoza (*Cronica Medica*, Aug., 1919).

Any indication of accumulation of gas in the intestine is early relieved by the administration of an **enema** consisting of an ounce (30 Gm.) each of **magnesia, glycerin, and water**. This, failing to afford relief, is followed by a large **enema of soapsuds** in which the **yelks of two eggs** are beaten up in an ounce (30 Gm.) of **turpentine** and strained, or an ounce (30 Gm.) of tincture of **asafetida** may be substituted for the turpentine, or probably more effective than any is an **enema of a quart (1 liter) of warm**

water in which an ounce (30 Gm.) of powdered alum has been dissolved. Nausea and vomiting may be overcome by giving draughts of hot water, thus washing out the stomach; the administration of small doses, frequently repeated, of tincture of *nuxvomica*, or a combination of *acetanilide* and *caffeine*, or the use of *cerium oxalate*. If the patient regurgitates small quantities of dark-greenish material, and this is continued in spite of the large draughts of hot water, the stomach-tube should be introduced and the stomach irrigated. The patient should be carefully watched during convalescence by both nurse and physician to anticipate the appearance of complications or abnormal symptoms.

Ovarian Grafting.—In the rabbit the whole ovary may be transplanted with success; but in the majority of cases, about 80 per cent., there was partial degeneration of the ovary. The ovary also may undergo either a fibrous or a cystic degeneration. The germinal epithelium persists in a small percentage of cases. The Graafian follicles and ova persist and mature some months after grafting, but ultimately tend to become cystic. It is unlikely that the whole human ovary can be grafted with success, but partial grafting is more likely to succeed, the grafting of the cortical portions of the ovary more especially.

Part of the ovary may ovulate and preserve its function of internal secretion. Carmichael (*Jour. of Obstet. and Gynec. of Brit. Empire*, March, 1907).

After-history of 7 women treated for hemorrhages, dysmenorrhea, or osteomalacia by reimplanting the ovaries at another point, two or three years before. In 1 case the ovaries were found functionally and anatomically normal more than three years after the operation. The results on

the whole suggest that the ovaries contain 2 kinds of tissue, as has been demonstrated for the testicles—glandular tissue with an internal secretion, besides the follicular apparatus. Better results will be attained if it is possible to destroy the latter while leaving unimpaired the tissue in charge of the internal secretion. Pankow (*Zentralbl. f. Gynäk.*, Aug. 8, 1908).

Transplantation of an ovary or portion of an ovary of an individual into the body of the same individual is a comparatively simple procedure which may be accomplished, in the majority of cases successfully, by attaching the cut surface of the graft to any well-nourished tissue, such as the parietal layer of the peritoneum, abdominal musculature, subcutaneous tissue, etc.

Even a very small portion of an ovary thus successfully grafted preserves the sexuality of the individual, and prevents symptoms of a premature menopause.

Heterotransplantation, transplantation of an ovary from one individual into the body of another individual, on the other hand, succeeds much less frequently, owing to the antagonism of the blood of every individual to tissues of another, this antagonism not existing between the blood and tissues of the same individual. F. H. Martin (*Surg., Gynec., and Obstet.*, xiii, 53, 1911).

The following conditions are regarded by the author as essential to the success of an **ovarian grafting** operation: (1) Absolute asepsis and the avoidance of strong antiseptics, which would destroy the vitality of the tissues. The apparent contraindications to this in the case of chronic pyosalpinx and salpingo-oöphoritis is met by the fact that the pus in such cases is usually sterile, and the tissues may be treated as "surgically clean." (2) The employment of minute or "seedling" grafts. (3) The presence of a good vascular supply in the tissue used as the bed for the graft. Muscle is entirely satis-

factory for the purpose. (4) The ovarian tissue should be left in contact with the body fluids within the peritoneal cavity until it is required for the grafting. B. Whitehouse (Brit. Med. Jour., Sept. 27, 1913).

In 12 cases of autoplasmic **ovarian transplantation** dating from December, 1914, 6 were menstruating regularly. From 5 the post-operative history was unobtainable. In 3 cases the graft was active 2 years after operation. The size of the graft varied from $\frac{1}{4}$ of a normal ovary to a section $\frac{1}{16}$ to $\frac{1}{8}$ of an inch in thickness. The abdominal wall just to the side of the median incision was the site selected for the transplant, making a pocket in the adipose tissue or beneath the rectus muscle. Menstruation appeared between the second and fifth months after operation. Phillips (Texas St. Jour. Med., xii, 213, 1916).

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OXALIC ACID ($\text{H}_2\text{C}_2\text{O}_4, 2\text{H}_2\text{O}$).—Oxalic acid is a caustic and corrosive poison obtained from sugar, from sodium formate, and from cellulose. It occurs as transparent, monoclinic crystals (resembling Epsom salts), having a strong acid taste. It is soluble in water and in alcohol, and slowly soluble in ether. Of all the irritant vegetable poisons, oxalic acid is the most important. As it resembles Epsom salts (magnesium sulphate), it may be readily mistaken for it, and as it may be easily procured either as oxalic acid or as salt of sorrel or essential salt of lemon (potassium binoxalate) to remove ink-stains or iron rust, to scour metals, to clean wood, or for use in photography, it is not infrequently taken by accident or with suicidal intent. Common sorrel (*oxalis acetosella*), containing oxalic acid in combination with potash potassium binoxalate), is sometimes used in infusion as a cooling drink or as an ingredient of salads; but such use is not to be commended, as danger lurks therein. A fatal case of poisoning by the use of sorrel has been reported (Hosp. Gaz., June, '86).

Cerium oxalate is the only official preparation of oxalic acid; its description will be found under CERIUM.

The dose of oxalic acid is from $\frac{1}{4}$ to $\frac{3}{4}$ grain (0.015 to 0.045 Gm.) well diluted in water, and may be repeated every three or four hours.

POISONING BY OXALIC ACID.—

When oxalic acid in substance or in strong solution is swallowed there is felt a hot, burning, acid taste during its passage downward, followed by pallor, clammy perspiration, violent prostration, intense abdominal pain, usually with vomiting of a dark-colored matter or even blood. If the poison be diluted, the vomiting may last a long while. In some cases, however, vomiting is absent; in others it is incessant until death.

The mucous membrane of the mouth, tongue, and throat is whitened, appearing as though it were bleached. More or less severe functional disturbance of the kidneys usually occurs, and in severer cases marked uremic convulsions not infrequently appear. The urine frequently abounds in oxalates, and glycosuria may be present. The nervous system appears to be also remotely affected, as, in cases of recovery from oxalic acid poisoning, spasmodic twitchings of the facial muscles, temporary loss of voice, numbness and tingling of the legs have been observed (Henry C. Chapman). Fry observes that many of the symptoms are apparently due to the reduction in the calcium content of the tissues by the precipitating action of the oxalic acid, and mentions convulsions, twitchings, muscular weakness, fall of blood-pressure, loss of tone and diminished function of cardiac muscle, changes in strength of pulse due to an increased susceptibility of the vasomotor nerve-endings to epinephrin, cerebral excitement, neurasthenic states, skin eruptions, vomiting, and constipation, from which he deduces the necessity for the use of **calcium salts** in the treatment of oxalic acid poisoning. It generally does its work quickly, and the corrosive symptoms are replaced by those of fatal collapse. When diluted sufficiently, so as to show no corrosive action, the acid is still highly poisonous, acting as a paralyzer of the heart (Fos-

ter). The minimum fatal dose, according to Taylor, is 1 dram (4 Gm.). Death may take place very quickly or may be delayed for several days.

Treatment of Poisoning by Oxalic Acid.

—To be efficacious, the treatment should be prompt and assiduous. After evacuating the stomach by **emetics** and **siphon** or **stomach-pump**, **chalk** (calcium carbonate), **magnesia**, and **plaster-scrapings** from the wall should be given, well stirred in water. Alkalies and their carbonates should not be given, as the salts formed are soluble oxalates. Should collapse appear, the patient must be kept in a **prone position**, **external heat** applied, and **circulatory** and **respiratory stimulants** given.

THERAPEUTICS.—Poulet proposed the use of this drug in **asthma**, **capillary bronchitis**, and **tuberculous bronchitis**, but it is seldom employed. W.

OXALURIA.—This signifies a persistent excess of calcium oxalate in the urine. Calcium oxalate may occur as a sediment either in acid or alkaline urine, but most often in the former, where it is frequently associated with uric acid deposits; in alkaline urine its most frequent associate is the triple (ammonio-magnesium) phosphate. Uric acid may be oxidized to oxalic acid. A few crystals may occur in normal urine after standing for a long time. Transient oxaluria may follow ingestion of acid fruits or foods containing oxalates (cacao, tea, pepper, sorrel, spinach, rhubarb, etc.). Calcium oxalate is also excreted in excess when an excessive diet of flesh and fat is used. The ultimate source appears to be nucleins and nucleo-albumins. Oxaluria is often associated with marked dyspepsia and hypochondriasis or neurasthenia, dependent upon disturbed metabolism; in gouty cases; in wasting diseases, as in tuberculosis, diabetes mellitus, and cancer; in catarrhal jaundice, spermatorrhea, and with “mulberry calculi”; and in general paresis of the insane.

Detection of Calcium Oxalate.—Calcium oxalate appears as a sediment in 2 forms—oftenest as minute, regular, highly-refracting octahedra; more rarely as hour-glass- and dumb-bell-shaped crystals. The octahedral crystals have 2 crossed axes, giving a star or envelope appearance. Presence

of calcium oxalate is not necessarily an evidence of its increased excretion, but may be due to absence of the acid phosphates which normally keep it in solution.

OXYGEN AND OZONE.—Oxygen was discovered in 1774 by Scheele, in Sweden, and Priestley, in England, independently of each other, and described under the names of “empyreal air” and “dephlogisticated air.” The name oxygen was given to it by Lavoisier some time afterward. In the atmosphere oxygen exists in a free and uncombined state (20 to 23 per cent. by volume) mixed with nitrogen. Oxygen-gas is tasteless, colorless, and odorless. It is heavier than air and eight times heavier than hydrogen. When liquefied under pressure, it has a bright, sky-blue color, has a specific gravity of 1.13, an acid reaction, and a temperature of -312° F. (-191° C.). Upon exposure to the air, reconversion to gaseous oxygen is very rapid. Water is a combination of oxygen (8 parts) and hydrogen (1 part) by weight. Under certain conditions it appears under the allotropic forms of ozone and autozone.

PREPARATION.—For experimental purposes oxygen may be obtained by mixing finely powdered black manganese oxide (1 part) and potassium chlorate (4 or 5 parts), heating the mixture in a flask or retort, and receiving the gas in an inverted jar over water. All the oxygen comes from the chlorate, the manganese remaining quite unaltered. Although the process is very simple, certain precautions should be observed if the gas be intended for inhalation. The manganese oxide should not contain any combustible matter, or an explosion will result; a small portion should be first heated in a metal cup, should there be any doubt of the purity of the manganese. The first portions of gas should be allowed to escape, as they are contaminated by the atmospheric air of the apparatus and a little chlorine. The gas as evolved should be passed through three or four wash-bottles containing water, and to the first of these should be added about $\frac{1}{2}$ per cent. of caustic potash (to absorb any free acid), to the second about $\frac{1}{2}$ per cent. of silver nitrate (to absorb any free chlorine). The

last washings should be with pure water. The gas may then be collected in a suitable gasometer and kept for a short time, or in rubber bags if wanted for instant use. Oxygen is now made on a larger scale, commercially, directly from atmospheric air, and is sold at a very low rate, delivered in steel cylinders, generally compressed so that a cylinder containing one hundred to two hundred gallons is of a convenient size for handling. From these cylinders the gas is drawn off into a gasometer or rubber bag, for office use or for single administration.

PHYSIOLOGICAL ACTION.—Pure oxygen, *when inhaled*, is irritating to the air-passages; small animals confined in it are seized with convulsions and die in a few days from intense congestion of the lungs. Bornstein, from personal experiment, concluded that man can stand oxygen at a pressure of two atmospheres for twenty or thirty minutes without harm. When a moderate amount is inhaled in health, no irritation occurs; after the inhalation of from 4 to 8 gallons of pure oxygen, there is an increased activity of the circulation with some nervous exhilaration. The respirations are apparently unaffected. Slight giddiness may be present for a few moments, but no vertigo nor headache. In addition to the acceleration of the pulse there are evidences of increased oxygenation of the blood in the lips and finger-nails and in cicatrizing wounds, with granulation tissue. Salvetti, Kollman and others note a diminution in the amount of uric acid, owing probably to the fact that a greater quantity is oxidized in the system. The digestion and appetite improve and assimilation is increased. Like all stimulants, oxygen first excites and then depresses. It must be borne in mind that oxygen can only be taken up by the blood in definite quantities, for it forms a chemical compound with the hemoglobin known as oxyhemoglobin. In overdose the pulse becomes rapid and strong, the blood-pressure being raised, and then spasmodic contractions of the extremities appear. A deficiency of oxygen, according to Kuhn, Aldenhoven and others, is a potent stimulus, for the production of new blood-cells, and a slower increase in hemoglobin.

When oxygen is administered in the form of the *oxygen bath* (90° to 95° F.—32° to 35° C.) Baediker has found that the most important effect is the lowering of high blood-pressure. In persons with normal or low blood-pressure, the changes were very slight. Where the blood-pressure was markedly reduced there was a coincident diminution in the size of the heart (1 to 2 cm.). When the blood-pressure remained unchanged the cardiac dimensions were not appreciably altered. When the blood-pressure was lowered, the pulse rate declined and respiration improved in rate and quality. These effects persist only a few hours after the first bath, but after from 15 to 20 baths very prolonged and even permanent physiological and therapeutic effects were observed.

When oxygen is used in the *liquid form* it produces refrigerant effects when applied to the skin—from a stimulating coldness and local anesthesia to congelation with vesiculation of the surface—varying with the length of application (three to thirty seconds). In addition there is a germicidal action resulting from the use of pure oxygen in its most concentrated form. As a freezing spray it is quicker and more positive in its action than those now in use; it produces a much lower temperature than carbon-dioxide snow; it is more stable than liquid air, and is a non-toxic germicide.

When oxygen is given by *subcutaneous injection*, it acts as a general and local tonic, and increases the elimination of waste matters. The region injected swells and the gas gradually disappears by absorption in from two to twenty-four hours.

THERAPEUTICS.—Oxygen—whose physiological action is too well known to warrant repetition—may be administered in medical or surgical practice in various ways: by *inhalation*, either pure, mixed with atmospheric air, nitrous oxide, ether, chloroform, or other substance; by *infusion* into the pleural or abdominal cavity; by *injection* into tuberculous joints or into abscess cavities, carbuncles, furuncles, etc.; by *subcutaneous injection*; by *local application* of a stream of gas or in solution as oxygen-water, liquid oxygen, etc.

Uses by Inhalation.—Inhalations of oxygen gas are, in a general way, indicated in conditions where there is a deficiency of oxygen in the blood, manifested by symptoms of **asphyxia**, **dyspnea**, or **disturbed nutrition**, or when there is some **functional disturbance of or impediment to respiration**.

We find inhalations of oxygen useful and curative in the second and third stages of **pneumonia** when there is present a deficient aëration of blood (cyanosis and dyspnea), with consequent heart distention. The pure gas may be used, but better results are obtained by diluting it with 10 per cent. of nitrous oxide. The inhalations may be applied at intervals as required, or it may be necessary to keep them up continuously until all danger is passed.

Aron finds that the results of oxygen in chlorosis are absolutely negative. In **cardiac or pulmonary dyspnea** a slight benefit was observed, but this ceased when the inhalations were suspended. Oxygen is not to be compared with artificial respiration in **syncope** or **morphine poisoning**. In that of **carbon monoxide**, oxygen proved very useful, as also in **aniline poisoning**, and to antagonize the **disturbances caused by rarefied air**. A convenient instrument for prompt resuscitation in these various disorders is the "pulmotor." The operator applies a face mask connected with the storage cylinder, turns a key. The apparatus then deals out the oxygen in measured quantities and insures its penetration into the lungs.

Oxygen inhalations are also beneficial in **advanced bronchitis**, especially in old persons. In **stenosis of the larynx**, **croup**, **diphtheria**, **emphysema**, and in **edema**, or **marked congestion of the lungs** the dyspnea is greatly relieved by oxygen inhalations. In **cardiac asthma** it has been shown that the condition of the heart muscle and of the aorta is an active or predisposing cause. If the organic lesion be overlooked, and a good prognosis given, surprise may be occasioned by the sudden death of the patient from heart-failure. The accentuation of the second aortic sound is the most reliable sign. The dyspnea and cyanosis of **cardiac insufficiency**, Heitler says, may be promptly

relieved by the combined use of morphine and ether hypodermically, with inhalations of oxygen.

Catlin recommends oxygen as the remedy for profound **shock**, either from **hemorrhage** or **nervous strain**. He has used it successfully in **hemorrhage** at the sixth month of **pregnancy** followed by **miscarriage**, where the prostration was absolute, with shock and constant vomiting. He has also found oxygen inhalations of benefit in **typhoid fever** where the prostration was marked.

Oxygen inhalations are useful in the resuscitation of persons **asphyxiated by coal-gas**, **sewer-gas**, **hydrogen sulphide**, **carbon oxide** and **dioxide**, and **chloroform-vapor**.

In **simple anemia**, in **pernicious anemia**, and also in **leukemia** oxygen inhalations have been followed by great improvement.

As a stimulant inhalation and as a nervous sedative, inhalations of oxygen-gas (60 parts) mixed with nitrous-oxide gas (40 parts) are highly commended.

The combination of oxygen-gas with nitrous oxide or with the vapors of ether or chloroform has been used for the purpose of overcoming the disadvantages of the latter remedies. Oxygen decreases the danger and obviates the untoward effects. When oxygen is used in combination with ether for **general anesthesia**, we observe less **vomiting**, less **pallor**, and less **post-operative depression**. F. H. Markoe states that if anesthesia be induced by oxygenated nitrous oxide, it can be most satisfactorily and safely prolonged with oxygenated ether. Robert Abbe concurs in the opinion of Markoe, and remarks that there is no question of a gain of oxidation during etherization by the combined use of oxygen and ether. The patient's complexion is pinker, the blood in the wound more arterial; the minute arteries seem to spurt more, but the blood clots quickly, so that there is no greater hemorrhage.

Oxygen increases the value of anesthetics as regards life, without decreasing their anesthetic effect. Investigations made by J. T. Gwathmey upon a series of 100 cats of similar size, etc., showed that, regardless of the anesthetic used, animals lived twice as long with oxygen as when air was used.

Oxygen Baths.—Oxygen baths have been found useful in **cardiac disorders with hypertension—arteriosclerosis, aortic insufficiency, chronic nephritis, asthma, Basedow's disease**—in which they have been found to reduce the limits of the dilated heart, to lower the blood-pressure, and to improve the rate and quality of the pulse and respirations. They are *contraindicated* where the blood-pressure is much below normal, especially if associated with mitral defects or profound anemia.

In **functional neuroses—neurasthenia, hysteria, motor excitability, and neuralgia**—they exert a sedative effect, a feeling of well-being and sleep, and in some cases exhibit marked analgesic properties.

Internal Administration.—Oxygen-water is made by charging cold distilled water with oxygen-gas under pressure. It is bottled in siphons (preferably) or other strong bottles, under a pressure of 150 to 200 pounds. When wanted for use it is drawn off by pressure on the siphon lever, or if in bottles, with a champagne-tap.

The use of oxygen-water is advised in **chronic dyspepsia**, and in **headaches of digestive or neuralgic origin**.

In general **systemic torpor** 1 or 2 tumblerfuls of oxygen-water after meals will prove beneficial.

Subcutaneous Injections.—These have been found by Lope (Revista Med. de Puebla, Mex., Dec. 15, 1918) to recall to life many patients otherwise beyond relief; among these were cases of **asphyxia, operative or induced pneumothorax, pneumonia**—all in which dyspnea was intense and failed to be aided by inhalations. From 150 to 200 c.c. are injected with a Pravaz syringe connected with the tank, interposing if possible a graduated jar containing water, into which the gas needed is allowed to flow. Others have used injections of oxygen in **bronchopneumonia, pertussis** and other dyspneic disorders.

Local Uses.—Stoker describes the local treatment of **ulcers and wounds** by the direct application of oxygen-gas. For this purpose he states that the oxygen may be diluted with pure air according to the requirements of each case. It is not necessary that an absolute vacuum over the parts treated should be produced. An oval rubber receptacle or cup covers the

part to be treated and the gas is supplied to it from a rubber bag by means of tubing. Pure oxygen causes a great deal of pain, but some patients can stand it well.

In oxygen we have an excellent body for combating **surgical infections** without at the same time injuring the cells. Thiriar leads the gas directly over the raw surfaces and into the infected tissues, so as to bring about a continuous oxygenation. In the following affections a rapid cure was brought about: In **suppurative arthritis** of the knee, the pus is evacuated by lateral incisions and the gas then passed through the joint; in **purulent and tuberculous peritonitis**, in **empyema**, in **gangrene** with the formation of gas, and in **furuncles, carbuncles, and anthrax**. The gas is frequently injected into the dead tissue and the surrounding induration.

Liquid oxygen has been used in a variety of surgical diseases. Bang applies it by wrapping a pledget of cotton around an applicator making a ball about the size of the thumb, immersing this into the bulb of liquid oxygen, and holding it over the surface to be treated for a period of time varying according to the result desired. Healing surfaces should be protected by a layer of gauze, as the cotton will freeze fast to the surface if it remains in contact for more than a few seconds. As a **local anesthetic** it may be used in place of the freezing sprays.

Liquid oxygen has been used with success in the treatment of **furunculosis, suppurating bubo, epithelioma, lupus, ulcers (varicose, traumatic, syphilitic, and tuberculous), gangrenous ecthyma, chancre, psoriasis, warts (verruca), vascular nevus, and cancer of the tongue**. In **suppurating glands or cysts** that are breaking down, the pus-sacs may be frozen after exposure, and the sac and contents removed *en masse*. In **leg ulcers**, applications of liquid oxygen will promptly convert foul, indolent sloughs into clean, granulating surfaces. A single application will often remove warts.

For the local uses of oxygen in solution see HYDROGEN DIOXIDE.

OZONE.

There has always been quite a considerable discussion concerning the nature of ozone, but the consensus of opinion is that

it is an allotropic or modified form of oxygen. It was discovered in 1839 by Schönbein, of Basle, who noticed that dry oxygen, or atmospheric air, when exposed to the action of a series of electric sparks, emitted a peculiar and somewhat metallic odor, resembling that of phosphorus, chlorine, or sulphur. This odorous principle (electrified oxygen) he called ozone.

Ozone is a colorless gas, having a characteristic odor. It is insoluble in water (pure water will absorb about 8.81 per cent. of ozone, the larger part, however, being converted by the water into oxygen without the formation of hydrogen dioxide) and in solutions of acids or alkalis, but is absorbed by a solution of potassium iodide. It is soluble in oils, some of them taking up as much as 25 volumes per cent. Ozone is decomposed into oxygen by heat, gradually at 212° F. (100° C.), and instantly at 554° F. (290° C.) with an increase of 50 per cent. in volume.

It is a powerful oxidizing agent, and possesses strong bleaching and disinfecting properties. It corrodes cork, rubber, and other organic substances, and rapidly oxidizes iron, copper, and even silver, when moist, as well as dry mercury and iodine. The absorption of ozone by these and other agents is not attended by any diminution of volume. Oxygen when ozonized diminishes in volume (in the proportion of 3 to 2, according to Soret); when the ozone is decomposed by a metal or other substance, one-third of it enters into combination, while the remaining two-thirds, which is set free as ordinary oxygen, occupies the same bulk as the ozone itself. Ozone may be liquefied by cold and pressure (125 atmospheres), and in that state it has an intense-blue color. Liquid ozone boils at 222.8° to 226.2° F. (106° to 141.2° C.), and if inclosed in a glass tube changes to a blue gas, which again reverts to the liquid state upon being cooled.

PREPARATIONS AND DISTRIBUTION.—Ozone exists naturally, in moderate and variable quantities, in atmospheric air. It is formed during thunder-storms and by silent electrical discharges in the atmosphere. It is evolved during the process of evaporation of water, especially of salt water, and also a result of the respiration of plants, especially those be-

longing to the *Coniferae*. It is therefore found in nature at the sea-shore; in forests, especially in the pine-woods; at the summits of mountains and of high towers. On the other hand, it is usually absent in crowded cities and where organic matter is undergoing slow oxidation, except after a thunder-storm. A great amount of ozone is formed in the mist rising from the cold ground, under a clear sky, on a calm autumn or winter day. Atmospheric ozone, according to Schönbein, is only generated in any considerable quantity when oxygen, moisture, and sunbeams combine, as exemplified and utilized in the bleaching of linens upon the lawn. According to the same authority, under the influence of light the green foliage of plants exhale both ozone and neutral oxygen, both of which are again taken up in part by the growing cells of the plant.

Ozone may be prepared artificially by oxidizing phosphorus in moist air; by the electrolytic decomposition of water; by the slow oxidization of ether, oil of turpentine, and other essential oils; by the action of strong sulphuric acid upon a mixture of potassium permanganate and oxalic acid; by the action of strong sulphuric acid upon barium dioxide; and by subjecting a current of oxygen to the action of the static electrical current.

Although the production of ozone by means of static electricity was discovered in 1839, it was not until 1854 that ozone was obtained in any appreciable quantities by von Siemens. Andrews and Tait discovered that the silent electrical discharge between very fine points would yield the maximum of ozone; and that the intermittent discharge, accompanied by the emission of sparks, caused a considerable amount of ozone produced to be reconverted into ordinary oxygen as fast as it was formed. Von Siemens's apparatus consisted of a modified Leyden jar, made by coating the interior of a long tube with tin-foil, and passing over this tube a second wider tube coated with tin-foil on its outer surfaces. Between the two tubes a current of dry oxygen is passed, which becomes electrified by induction, on connecting the inner and outer coatings with the terminal wires of an induction coil (Ruhmkorff coil) or with a

Holtz static machine. By this means it is said that from 10 to 15 per cent. of the oxygen may be converted into ozone. Von Siemens and Halske have since improved the original apparatus in many ways.

Houzeau's apparatus consists of a glass tube containing within a stout platinum filament, and wrapped on the outside with a spiral of copper wire or other good conducting material. One of the rheophores of the induction coil is connected with the platinum wire, the other with the copper spiral. A current of dry oxygen-gas is allowed to pass through the tube.

The quantity of ozone produced is increased by lowering the temperature, about 50 per cent. of the oxygen being converted into ozone at -88° F. (-31.1° C.). Based upon this principle, W. J. Morton devised an effective machine which is much improved in detail, the output of the machine being measured in milligrams of ozone per minute, and the dosage regulated accordingly.

TESTS FOR OZONE.—In the presence of potassium iodide and moisture ozone will cause the liberation of free iodine (one-third of its volume acting in this liberation and two-thirds escaping as oxygen). Based upon this, test-papers are prepared by immersing sheets of unsized (bibulous) paper into a solution of starch and potassium iodide; these sheets are dried and afterward cut into strips of convenient size. For use one of the strips is moistened and exposed; if ozone be present in the air, it will liberate free iodine, which in turn will act upon the starch, producing a blue color (iodide of starch).

Bibulous paper dipped into tincture of guaiac will turn blue upon exposure to ozone.

Moistened indigo test-papers are decolorized by ozone.

In applying these tests it should be remembered that most of the reagents react similarly to hydrogen dioxide and to ozone, and allowances should be made therefor.

PHYSIOLOGICAL ACTION.—The air contains a minute quantity of ozone, sufficient to act as a stimulant to the respiratory tract. To the absence of ozone in the

air has been attributed many ailments, especially neuroses such as hay fever and the "nervousness" of which women most frequently complain. The fact that such disorders seem to be improved after a thunder-storm has apparently sanctioned this view and led to the use of ozone as a remedy. In concentrated form it causes, when inhaled, inflammation of the respiratory tract and coagulation of the blood in the superficial arteries, though it restores the fluidity of the blood outside of the body. The local effect is attributed to its destructive influence upon the epithelium of the respiratory tract and inhibition of its functions, besides interference with the discharge of carbon dioxide. The toxic effects thus brought about unfavorably affect general metabolism and cause depression of cardiac action.

Hill and Flack found a concentration as low as 1 in each million to be irritating to the respiratory tract, while exposure for two hours to a concentration of 15 to 20 in the million was not without evident danger to life. The cough and headache produced by ozone, however, give ample warning. The respiratory metabolism is reduced by ozone, in concentrations even less than 1 part in the million, and there is no conclusive proof of a preliminary stimulation of metabolism preceding the fall. They found that exposure for ten minutes to 2 parts in 10 millions of ozone may lower the rectal temperature of rats as much as 3° F. (1.6° C.). They explain the beneficial effects from ozone ventilating systems by the effect of the ozone on the nervous system—by exciting the olfactory nerve and those of the respiratory tract and skin.

W. G. Thompson studied the physiological action of the ozone preparations in a series of experiments on dogs. 1. When injected in the circulation in full strength, —i.e., 15 volumes per cent.,—they have a very destructive action upon the blood, thereby ultimately having the effect of reducing rather than of oxidizing agents for the tissues. 2. Acting through the stomach or intestine, they may similarly affect the blood, and in addition they destroy the gastric and intestinal mucous membrane. 3. Given in medicinal doses by

the stomach, their only benefit, if any, consists purely in their local action in the alimentary canal, in possibly preventing abnormal fermentations. 4. If so used, care should be exercised, owing to the great variability in strength of different preparations. 5. Ozone is of no real value to the tissues, whether inhaled or drunk in fluid preparations, and it may be exceedingly harmful.

THERAPEUTICS AND HYGIENE.—

Ozone is utilized in the forms of ozonized air obtained through the use of one of the various special electrical apparatuses or as furnished by nature at the sea-shore, mountains, or in the pines; ozonized water, prepared by charging distilled, sterilized water with ozone by means of special apparatus—or ozonized oil—oil saturated by passing ozone or ozonized oxygen through it.

Ozone is thought to be nature's purifier, acting by prompt oxidation upon decaying, putrescent organic matters, and converting them into harmless products, such as nitrous and nitric acids, water, hydrogen dioxide, and carbon dioxide; but its chief value in medicine is derived from its deodorizing and disinfecting powers.

The writer recommends ozone for **swimming pool purification** for the following reasons: It is reliable as a disinfectant and, unlike the halogens, its use results in no objectionable odor or taste; it improves the appearance and transparency of the water, permitting a longer continued use of the pool; it is cheap, costing in the case of a 60,000 gallon pool only from 11 to 15 cents a day if alternating electric current is available, and where direct current must be converted into alternating current an additional 10 to 14 cents. Manheimer (Jour. Amer. Med. Assoc., June 29, 1918).

In **diphtheria, croup, pertussis, variola, scarlet fever, cholera**, and other **infectious diseases** ozone generated in the room is said to improve the condition of the patient and minimize the contagion. Vapors of turpentine, eucalyptus, and similar substances will furnish a certain amount of ozone.

Personal experiments by Foulerton and Ransome have demonstrated that dry ozone has no appreciable action on the vitality of micro-organisms; that prolonged exposure does not diminish the pathogenic virulence of *Bacillus tuberculosis* (in sputum), *Bacillus mallei*, or *Bacillus anthracis*; that ozone passed through a fluid medium containing bacteria has bactericidal power; that any purifying action which ozone may have in the economy of nature is due to the direct chemical oxidation of putrescible matter, and that it does not in any way hinder the action of bacteria, which latter are, indeed, in their own way, working toward the same end as the ozone itself in resolving dead organic matter to simple non-putrescible substances.

Jordan, Carlson, Sawyer, Beckwith, and others conclude, in reference to the alleged purification of air by ozone generators, that the amount necessary for this bactericidal action is so great as to affect injuriously human beings.

In cases of **cachexia, anemia**, and **malnutrition** inhalations of ozonized air have been found beneficial. H. S. Norris observed improvement in cases of **phthisis**, following the use of ozonized water, taken internally. Schmidt reports excellent results following parenchymatous injections of ozonized water in two cases of **epithelioma**. He considers that it may be useful also in **sarcoma** and **tuberculous growths**. He reports the successful use of ozone-water as a local application in **diphtheria**.

W. J. Morton and C. C. Rice have employed ozone-gas locally in cases of **atrophic rhinitis** and **pharyngitis sicca** (the patient holding the breath after taking a deep inspiration) by allowing a current of ozonized air to pass into the nostrils through a tube, intermittently. Rice has used ozonized sweet oil (8.75 volumes per cent.) in **ozena**; it thoroughly deodorized the nasal cavities.

In the treatment of **gas poisoning**, oxygen administered by a Haldane face mask, a Stokes intranasal tube, or an oxygen chamber gives excellent results, as evidenced by the disappearance of the clinical symptoms and by the ordinary exercise tests.

The chief symptoms of **anoxemia** are nocturnal dyspnea, with or without sleeplessness, and physical distress out of proportion to the exercise causing the dyspnea. Haldane states that a small degree of anoxemia—deficiency of free oxygen in the blood—has serious results and that such an anoxemia is common. Both theoretically and practically the best method

of supplying the oxygen deficiency is the administration of oxygen. The earlier the oxygen is administered, the greater the chance for recovery, especially if pulmonary edema has developed. Cummins, Douglas, Ryle, Peters, Shufflebotham, Sowry, and Hamill have all obtained similar results with this plan of treatment. W. and S.

P

PANCREAS, DISEASES OF.—PANCREATIC HEMORRHAGE AND PANCREATITIS.—These two conditions are usually considered together owing to their kinship as to symptomatology, pathogenesis, and treatment.

SYMPTOMS.—Although the patient may present a history of gastrointestinal disorder, with uneasiness in the abdomen, attacks of colicky pain, nausea and even vomiting, attributed, as a rule, to mild lithiasis or gastritis, the onset is usually sudden. The attack is generally initiated by intense diffuse pain in the epigastrium which may be constant or paroxysmal, and is intensified by motion and emesis. It is not clearly localized, but radiates from about the epigastrium over the upper portion of the abdomen or to the left of the median line, when the tail of the pancreas is the seat of the lesion. Any degree of deep pressure over the epigastrium causes intense pain, the whole region being exceedingly tender.

Attacks of pain in the epigastrium had previously been present in the majority of 44 cases. The acute stage usually set in with violent epigastric pain, eructations, vomiting, as well as a tendency to collapse. The only symptom to some extent pathognomonic was a tender resistant area in the epigastrium. The Cambridge reaction proved of little value. Körte (*Arch. f. klin. Chir.*, xcvi, 3, 1912).

Acute pancreatitis is more often unrecognized than it is diagnosed because it is comparatively infrequent while there is no sign or symptom pathognomonic of the disorder; generally the desperate condition of the patient makes operation imperative without the formality of a definite diagnosis. A sudden acute abdominal seizure, overwhelming pain, in an apparently healthy, usually obese individual, accompanied by incessant vomiting, upper abdominal distention, a transverse resistance not easily elicited, weak pulse, subnormal temperature, collapse, and sometimes cyanosis, should suggest acute pancreatitis. The previous history will usually show attacks of severe epigastric pain which have been regarded as gall-stone colic and have been treated as such. Not infrequently the first attack of this kind occurs during or soon after a pregnancy. Deaver (*Ann. of Surg.*, lxxviii, 281, 1918).

In the course of some hours there is usually some swelling of the epigastrium. Any suppuration is accompanied by leucocytosis and sweating. Some jaundice may appear owing to obstruction of the common bile-duct by a gall-stone in the diverticulum of Vater, swelling of the duodenal mucosa, etc.

Nausea and vomiting are early symptoms, increasing in severity, but without relief. The vomitus consists of food and mucus chiefly, but may contain blood in various stages of disintegration. Marked prostration, or even collapse, soon follows. The

temperature is normal or subnormal in cases of hemorrhage without inflammation, and may not be high in the inflammatory cases in which the fever may be preceded by chills. The bowels are usually constipated, but there may be diarrhea.

The disease is usually fatal within a few days. In the exceptions, the acute symptoms gradually subside. The patient may either recover or develop chronic pancreatitis.

Should the patient's life be prolonged peritonitis appears, the pain and tenderness continuing and the abdominal muscles becoming rigid. Marked distention of the abdomen, constipation, a rising temperature, a rapid and thready pulse, intense thirst, delirium, coma then occur in rapid succession, ending in death.

If an abscess occur in the pancreas, it may rupture into the intestine, and cause blood, pus, and pancreatic detritus to appear in the stools, thus denoting necrotic foci in the pancreas.

Case of acute hemorrhagic pancreatitis and a second in which there were only minute foci of fat-necrosis in the interstitial tissue of the pancreas. In the latter case there was a history of recurring attacks of abdominal pain and vomiting, subsiding after a few days, and the pancreas showed signs of chronic inflammation. The temperature was subnormal in both the women; they were 68 and 78 years old and the first died in three, the other in thirteen days. The localization of the pain in the epigastrium and the meager findings on palpation, in contrast to the grave general condition and distress, pointed to pancreatitis. C. Verdozzi (Policlinico, May 1; Med. Sect., No. 5, 1914).

DIAGNOSIS.—Physical examination may reveal a deep-seated swelling, or mass, with tympany on

percussion because of the presence of the overlying stomach and intestine. The urine may contain albumin, casts, sugar, and, as shown by Opie, lipase, the fat-splitting ferment.

Sudden pain in the epigastrium in a well person, or one suffering from occasional indigestion, and early collapse with vomiting, followed in twenty-four hours by a circumscribed resistant swelling, tympany, and tender spots throughout the abdomen, should suggest acute pancreatitis.

In a severe case of acute hemorrhagic pancreatitis there was a confused picture of shock and hemorrhage, so much so that but for the localization of the pain to the upper abdomen and the history of regular menstruation, the diagnosis would have been ruptured ectopic pregnancy. Gillespie (Lancet, April 22, 1911).

About 25 per cent. of 70 soldiers in a recent epidemic of mumps presented nausea, loss of appetite and epigastric tenderness, with actual pancreatitis in 1 case. The enlarged and tender pancreas showed vigorous pulsation from the aorta, but not in a second case. It is probable that participation of the pancreas is responsible for the epigastrium symptoms in mumps. Zimmerli (Correspbl. f. schweizer Aerzte, Sept. 14, 1918).

Perforating ulcer of the stomach or duodenum may be suspected, but can generally be excluded by a previous history of pain after food, and hemorrhages, and the more general peritonitis that usually follows. *Duodenal cases* may present much difficulty, as perforation may occur without any previous history of pain or disturbed digestion. The symptoms develop suddenly and the pain and collapse may be as marked. Moreover, duodenal ulceration occurs chiefly in the same class as pancreatic disease; that is, in males over 40

years old. *Irritant poisoning* may be excluded by the history and the character of the vomit. *Biliary colic* is excluded by the absence of collapse, a history of previous attacks, and jaundice is present, but its frequent absence must be kept in mind. *Intestinal obstruction* is the condition most frequently suspected. The onset, however, is less sudden; the distention and tenderness are not confined to the epigastrium, and a tumor may be found at the seat of obstruction. Inflation of the colon, carried out with due care, may determine the seat of obstruction.

The main point in acute hemorrhagic pancreatitis is to think of the possibility of acute pancreatitis when called to a patient with symptoms suggesting ileus, cholelithiasis, perforation peritonitis or appendicitis. The lack of rigidity of the abdominal wall, the temperature higher than with ileus, the peculiar sallowness and the obstinate pain in the epigastrium speak for pancreatitis. E. Monnier (*Correspondenz-Blatt. f. schweizer Aerzte*, March 1, 1911).

In one of 2 cases of syphilitic pancreatitis, profuse diarrhea was the prominent symptom. Positive Wassermann and functional tests. Specific treatment produced no benefit, but after a week's rest and resumption of the same measures a cure was soon obtained as in the first case. Udaondo (*Prensa Med. Argent.*, Nov. 20, 1917).

ETIOLOGY AND PATHOGENESIS.—Acute pancreatitis or hemorrhage into the pancreas may be caused by many conditions. It may occur, as it does in other structures, in the course of infectious diseases; as a manifestation of hemophilia or purpura; as a complication of various tumors, of a crushing injury, or a blow on the abdomen, lacerating the gland.

Pancreatitis following mumps has been known many years, Cuche having noticed it among soldiers in 1897, Fabre in 1887, and Mondière in 1833. Pain is by far the most marked symptoms; then nausea and uncontrollable vomiting. Diarrhea also occurs. Glycosuria and steatorrhea have been noticed. It is important, not only that pancreatitis may precede the parotiditis, but may exist alone. L. Cheinisse (*Semaine méd.*, Feb. 21, 1912).

During a recent epidemic of 100 cases of mumps in Bukowina, 3 developed symptoms suggesting acute pancreatitis, but the syndrome subsided harmlessly in each in less than a week. Recovery was complete in about ten days after the first symptoms of mumps had been noticed. Each patient developed at about the fourth day of the mumps, herpes, intense frontal headache, vomiting suggesting ileus, fever with delirium, collapse, pains and tenderness above the umbilicus, intense acetoneuria and Cheyne-Stokes breathing, and in two the pulse became very slow. In each of the three the knee-jerk was abolished, as was also the case in 10 per cent. of all the mumps patients examined, and in all the cases with this finding the course of the mumps was exceptionally severe. Dracinski and Mehlmann (*Deut. med. Woch.*, July 30, 1914).

Deaver and most authorities attribute all cases of pancreatitis, acute and chronic, to micro-organismal invasion, even though it be admitted that certain systemic intoxications due to alcohol, syphilis, tuberculosis, or other unknown circulating toxins may produce degenerative lesions which may be classed as chronic pancreatitis. The retroinjection of bile into the pancreatic duct may, however, initiate an acute pancreatitis of severest type even in the absence of micro-organisms. Infection enters the gland

through four portals: By the systemic circulation, through the arteries of supply; by contiguity from adjacent viscera; by ascending infection of the duct from the biliary tract or duodenum; by infection by way of the lymphatics—from the gall-bladder to the pyloric region.

Under certain undetermined conditions, polymorphonuclear leucocytes immigrate into the pancreas in sufficient numbers to cause considerable lesions; this occurs more frequently in acute infectious diseases than in chronic diseases; as yet the lesions have not been correlated with clinical symptoms. Frothingham (Jour. Med. Research, April, 1909).

The writer's experience with diseases of the pancreas comprises 22 acute and 130 chronic cases. From the viewpoint of surgery the local factors are the more important, and the chief of these is direct infection. The damming back of active pancreatic secretion into the interstitial substance of the gland is likely to result in hemorrhagic pancreatitis. About 50 per cent. of all cases of pancreatitis are associated with demonstrable disease of the gall-bladder or common duct. In the majority of instances the infective agent in pancreatitis is carried by way of the lymphatics tributary to the pancreas. J. B. Deaver (N. Y. Med. Jour., March 23, 1912).

Acute pancreatitis caused in dogs by closing the outlet to the pancreas and inoculating the gall-bladder with bacteria. A gall-stone at the mouth of the common bile-duct is liable to cause the secretion to back up into the pancreatic duct, and acute pancreatitis is almost inevitable when infected bile thus reaches the pancreas. The pancreas tissue suffers from the infection which opens the door to secondary autodigestion of the tissue from the pancreatic juice with resulting fat-tissue necrosis. Nordmann (Arch. f. klin. Chir., cii, Nu. 1, 1913).

Pancreatic hemorrhage is sometimes found as the only lesion at autopsies after sudden death in persons apparently healthy. This condition has been termed *pancreatic apoplexy*. It is probably due to localized inflammation of the gland with autolysis in some cases, and in others to rupture of an atheromatous vessel, with embolism or thrombosis.

It may occur also from rupture of a diseased vessel. Chronic venous congestion caused by heart disease may lead to small, disseminated bleedings. In some grave cases hemorrhage occurs from unknown causes. It may occur with or without inflammation of the gland, owing to the digestive action of the pancreatic juice.

Acute pancreatitis and pancreatic hemorrhage are more frequent in males than in females, and tend to occur in stout people in whom there is a tendency to gastric or duodenal disorders, gall-stones; child birth has also been incriminated; pregnancy likewise. Mayo Robson has associated it with a deficiency of calcium in the blood.

Many cases of sudden death during or just after labor are on record; and some cases of pregnancy toxemia have been ascribed to this cause. Still later the use of drugs to produce the so-called half-sleep—scopolamine and other narcotics—as well as hypophysis substance as an oxytocic, were likewise held in suspicion. Mere coincidence seems responsible for what is known as false eclampsia, in which meningitis, pneumonia, etc., cause death at or soon after labor. A few cases are known to have been due to air embolism.

The writer's case was due to acute necrosis of the pancreas. The patient was corpulent and somewhat of an alcoholic. She ate very heartily just

before labor began and the latter lasted but two and one-half hours. Soon after expulsion of the placenta she collapsed and vomited, death occurring so soon after that air embolus was suspected. Autopsy showed that the pancreas was the seat of an acute necrosis. There were fresh, toxic lesions in the liver, due apparently to the escaped pancreatic ferments; but there had been no pancreatic hemorrhage. Saenger (Münch. med. Woch., June 17 and 24, 1913).

The hemorrhage may be limited to a part of the gland or it may infiltrate the whole gland and the retroperitoneal tissues, even rupturing into the lesser peritoneal cavity and filling it with blood.

Acute pancreatitis and pancreatic hemorrhage may be complicated with inflammation which not infrequently terminates in necrosis.

As Guleke and von Bergmann had already shown, a preliminary subcutaneous treatment of dogs with trypsin provides protection not only against the toxic effect of larger doses of trypsin, but also against the toxic effect of pancreatic substance introduced into the peritoneal cavity. The experiments of the writers show that the immunity is provided only against a certain amount of the pancreatic substance in the peritoneal cavity. In order to provide further protection, the imbedding of the pancreatic substance into the peritoneal cavity must be preceded by an immunization with increasing doses. These experiments furnish a further support for the view that the toxic effect of the necrotic pancreas does not depend alone upon the toxic effects of its proteolytic ferment. The immunity obtained by preliminary treatment with trypsin and pancreatic substance cannot be transferred to other animals. Joseph and Pringsheim (Mitt. a. d. Grenzgeb. d. Med. u. Chir., xxvi, 290, 1913).

Inflammation may, however, occur without hemorrhage; it then tends rather to suppuration than gangrene. Painful gastroduodenal disturbances have preceded in many cases, the inflammation evidently extending back along the duct. It is thus probable that indulgence in alcohol plays a part in its production.

In the 12 cases described by the writer the patients were nearly all corpulent and passing or past middle age. Gall-stone trouble was a factor in 2, gross error in diet and abuse of alcohol in 1. In 1 case the head was swollen and a few foci of necrosis were all that was found at the gall-stone operation. In 2 other cases the pancreas disease caused death from toxins in less time than usual with peritonitis from perforation. When there is much suppuration the course is generally milder. Rollmann (Deut. med. Woch., April, 1914).

MORBID ANATOMY.—Three varieties of acute pancreatitis have been recognized by Fitz: the hemorrhagic, gangrenous, and suppurative.

In *hemorrhagic pancreatitis* the gland is enlarged throughout or in some part, and infiltrated with blood, the color of which varies with the duration of hemorrhage and the severity of inflammation. A section may show a variegated surface, with opaque white spots due to fat-necrosis. Extensive hemorrhage may be found in the root of the mesentery in retroperitoneal tissue, and about the kidneys, especially the left. In these parts areas of necrosis of fatty tissue are often found.

Gangrenous pancreatitis follows hemorrhagic pancreatitis, but no distinct line of demarcation can be established. The gland or part of it may be converted into a dark-gray mass, wholly or partly separated from its

attachments and lying in the lesser peritoneal cavity or in the cavity of a large abscess. The surrounding peritoneal surfaces become covered with a fibrinous exudate. The sac of the lesser peritoneum may contain a large quantity of dark, offensive fluid in which masses of necrotic fat may be found. Perforation, with discharge of this exudate, may take place into the stomach or duodenum, and recovery follow.

In *suppurative pancreatitis* a single abscess or multiple abscesses may form, or there may be diffuse purulent infiltration of the surrounding tissues. Perforation into the stomach or duodenum may occur. Fat-necrosis is rare in these cases. Septic thrombus of the splenic vein may form and lead to infection of the portal vein and multiple abscesses in the liver. The spleen is not usually much enlarged. The pleura and pericardium may become infected by extension of the inflammatory process through the diaphragm. Various bacteria, especially the colon bacillus, are found in the affected tissues.

The ubiquitous presence of *fat-necrosis* in hemorrhagic and necrotic pancreatitis is a striking feature of disease of the pancreas. The condition is rarely met with apart from affections of this organ. It has been produced experimentally by inserting pieces of pancreas beneath the skin or into the subperitoneal fat, and by experiments on the pancreas itself. The areas vary greatly in size, some being as small as a pin's head, others as large as a hen's egg. They are soft in consistence.

According to Simon Flexner (1901) fat-necrosis is due to perversion of the pancreatic secretion and the direct

result of the action of the fat-splitting ferment.

Recent research suggests that the necrosis is the result of autolysis from activation of the pancreatic secretion by bacterial action, the bacteria penetrating into the pancreas in infected bile or intestinal juice. The resulting autolysis entails necrosis and the toxic substances then generated deep into the surrounding tissues induce the severe general symptoms as they are absorbed. H. Coenen (Berl. klin. Woch., Nov. 28, 1910).

Study of 10 clinical cases and extensive experiments on several dozens of dogs seemed to show that the disorder was the result of activation of trypsin ferment inside the gland. This activation occurred by way of the pancreatic duct from the action of bacteria or bile or of both together, or of enterokinase or of trypsin already activated in the duodenum. Exceptionally, the activation may be the work of bacteria arriving by way of the blood or lymph, or there may be embolism and thrombosis. But under all circumstances the direct causal agent is the activated trypsin, its action on the parenchyma causing the typical acute necrosis. Seidel (Beiträge z. klin. Chir., July, 1913).

The pancreas-ferment theory gives the most natural explanation of the peculiar clinical picture, in which symptoms of poisoning are most prominent, that leads rapidly to death in the worst cases, and takes a more benign course in others, according to the amount of the pancreas poison produced and absorbed. Consequently the prognosis depends on the quantity of toxin produced, which in turn depends on the extent of the local process in the gland. This is in agreement with the clinical experience that the cases of total necrosis rapidly prove fatal, and that the clinical picture and the findings on autopsy perfectly simulate those of a poisoning. Joseph Gobiet (Wiener klin. Woch., Aug. 28, 1913).

PROGNOSIS.—Many mild cases probably occur and recover, but severe cases are generally fatal, although Trafoyer has reported an instance of recovery after sloughing of the pancreas and its discharge by the rectum. A fatal ending may be due to collapse and occur within a few days, but cases that recover from the shock may succumb to septicemia some weeks later. Recovery is promoted by early laparotomy to arrest the hemorrhage, evacuate pus, or explore and drain the peritoneal cavity.

In a great majority of cases, an acute pancreatitis is grave from the beginning. Patients who survive the shock are apt to succumb to the effects of the necrosis of the glands unless suitable drainage is supplied. Where the cases begin with hemorrhage, early surgical intervention promises well. C. Beck (*Med. News*, Sept. 9, 1905).

Instance of necrosis of the pancreas with recovery. The patient was a man of 39 years, who developed acute pancreatitis secondary to cholelithiasis. There was no fat-necrosis and, after expulsion of the necrotic tissues, complete recovery followed. The urine contained a large proportion of sugar for a time, but after the pancreatic secretion found its way anew into the intestine all trouble from this source was at an end. The diabetes came on when the pancreatic secretion was diverted outward and ceased as it resumed its normal course. Oehler (*Beiträge z. klin. Chir.*, Feb., 1912).

TREATMENT.—The medicinal treatment is purely symptomatic. The extreme pain and the collapse require the subcutaneous injection of **morphine** and the administration of **stimulants** by the stomach or rectum, **cold compresses** over the **epigastrium**, or **hot fomentations**. In hemorrhagic

cases with a fatal collapse threatening, it may be justifiable to perform **laparotomy** and relieve the pressure on the solar plexus, to which death is probably due, rather than to loss of blood.

Even when operative treatment is being considered, internal measures should not be neglected. Chief among these are the dietetic, restricting the patient to a **strict anti-diabetic diet**, the advantages of which have been proved beyond question by his own and others' experience. As a further means to reduce the secretion of pancreatic juice, **sodium bicarbonate** by the mouth during meals has been recommended, but he does not think it necessary unless an operation is impending. **Sedatives** and **stimulants** are indicated, but saline infusion has not yet proved its efficacy in acute pancreatitis, and Pewsner's research seems to indicate that large amounts of salt are liable to do harm. **Complete rest in bed** is necessary, with **ice** over the pancreas at first and later warmth, guided by the patient's feelings. The writer has had the best result with **super-heated air**, not going above 80° C. (176° F.). **Washing out the stomach** may also be useful. In conclusion, he warns that patients who have passed through an attack of pancreatitis should be kept under supervision for several years, as the acute pancreatitis may recur or may pass into a chronic phase—the conditions are much the same as with appendicitis; and prophylactic measures are equally indicated. Dreesmann (*Jour. Amer. Med. Assoc.*, from *Med. Klinik*, June 25, 1911).

Exploration and drainage of the lesser peritoneal cavity and **evacuation of pus**, if any, are life-saving measures when the case has not progressed too far. In the inflammatory cases operation may be advisable as soon as an accumulation about the pancreas or in the lesser peritoneal cavity can be

demonstrated. In the mean time the patient's strength should be sustained as far as possible by **easily assimilable foods**.

In 96 cases of acute hemorrhagic pancreatitis on record, including some from the writer's practice, in all of which operative treatment had been applied, cure followed in 25. All the patients not operated on died. In 2 cases a second operation was required and the patients recovered. A secondary operation may be necessary also on account of gall-stones. In a number of the cases the patients have been in good health for years since the operation, the digestion being practically normal. Leriche (*Revue de gynéc.*, Oct., 1909).

Operation is the treatment indicated, unless the patient is in such severe collapse that the additional shock would surely be fatal. The object of operation is to drain the pancreatic secretion and the products of infection; this is best done by incising the tissue of the glands, as advised by Porter, and by carrying the drainage through the gastrohepatic omentum close above the lesser curvature of the stomach. Balch and Smith (*Boston Med. and Surg. Jour.*, Sept. 8, 1910).

The increasing tendency toward early operating in acute pancreatitis is to be commended. Dreesmann found on record, in 1909, 118 cases in which an operation was done, with recovery in 45 per cent. The proportion of recoveries was 80 per cent. in the 40 cases in which the **pancreas** has been **exposed and tamponed** early. H. Coenen (*Berl. klin. Woch.*, Nov. 28, 1910).

Early operation is of the greatest importance. Of 16 cases operated on during the first week, 11 recovered, while 5 died. Of 14 operated on in the third and fourth week, one-half died. It is to be hoped that, as with peritonitis, the cases will be sent earlier to the surgeon.

The median incision is the best method of approach, especially in the

early cases. It permits exposure of the bile-passages, not infrequently the cause of pancreatitis, at the same time. The pancreas itself is most readily exposed by division of the gastrocolic omentum. The organ is bluntly incised in several places, even when pus is not encountered, and drains introduced. W. Körte (*Annals of Surg.*, Feb., 1912).

Mortality statistics emphasize the importance of prompt diagnosis and early operation. In a first series of 16 cases operated before June, 1915, the writer had a mortality of 62.5 per cent. In a second series, early diagnosis having been made in 75 per cent. of cases, it was 13.6 per cent.

Operation is indicated in all cases *unless shock is extreme*, and **very rapid operation** is of extreme importance. The diseased pancreas may be exposed by any one of four routes: (1) through the gastrohepatic omentum, which is preferable; (2) through the transverse mesocolon; (3) through the gastrocolic omentum, and (4) in the late stages through the lumbar region. The operation consists of multiple punctures of the pancreas with blunt forceps and drainage of the gland with rubber tissue and gauze. The omentum is closed around the tube. Later treatment consists of a strict **antidiabetic diet** and **sodium bicarbonate** to reduce the pancreatic secretion. The case should be watched for several years. Linder (*Jour. Amer. Med. Assoc.*, Sept. 1, 1917).

For additional details, the reader is referred to the article ABDOMEN, SURGERY OF, in the first volume.

CHRONIC PANCREATITIS.

SYMPTOMS.—Although the symptoms of chronic pancreatitis are not clearly defined, its presence should be suspected when, in addition to chronic indigestion, there is more or less jaundice, emaciation, and a disposition to diarrhea with large stools. These develop insidiously, the dyspepsia, with anorexia, nausea, vomiting, epi-

gastric distention and flatulence. Pain radiating to the back and deep-seated tenderness and resistance in the pancreatic area may be elicited. Profuse salivation (*pancreatic sialorrhea*) is occasionally witnessed. Ascites may be caused by obstruction to the portal circulation. Glycosuria develops if the islands of Langerhans are involved.

In chronic pancreatitis nutrition is almost invariably impaired and the patient is emaciated, sometimes to an extreme degree. Digestion is disturbed. There is discomfort after eating, and often this discomfort can be associated with certain articles of food, particularly the carbohydrates. The discomfort does not appear to have any characteristic type. It may be a sense of oppression, fullness, or of actual pain. Vomiting occurs quite constantly, but it may be only at long intervals. It rarely occurs just after taking food unless the patient's condition is very grave, but may occur in the morning or some hours after taking food, and is usually preceded by some hours of discomfort. Constipation is the rule. Sailer (*Amer. Jour. Med. Sci.*, Sept., 1910).

The diagnosis of chronic pancreatitis is more difficult than that of the acute form. The leading and most constant symptom is pain, which varies from dull discomfort or ache to sharp lancinating or colicky pain quite like gall-stone colic. Slightly less frequent than pain is the history of nausea or vomiting or both. A third important symptom is jaundice. Impairment of the pancreatic function results in loss of weight. The bowels are constipated. The physical examination rarely affords much positive information and is of more value in excluding other conditions. The Cammidge reaction, even the improved or "C" reaction, does not render any assistance. J. B. Deaver (*N. Y. Med. Jour.*, March 23, 1912).

By the method of finger-point pressure, advancing gradually from all

sides toward the epigastrium as a center, one is easily able to demonstrate, in cases of pancreatitis, a more or less well-defined area of tenderness in which there will be one or two points of maximum tenderness, usually exactly in the midline, from one to two inches above the umbilicus. There is rarely any superficial tenderness except in the severity of the onset. During the subsiding stage one will frequently have to go moderately deep with the finger before eliciting tenderness.

Another useful diagnostic feature is the presence of tenderness in the left costoiliac space behind, in which situation one comes more or less directly upon the left half of the gland. E. Archibald and E. J. Mulally (*Can. Med. Assoc. Jour.*, Feb., 1913).

The writer found only 2 cases of diabetes mellitus among 250 cases of chronic pancreatitis. In chronic non-biliary pancreatitis there are digestive disturbances with pains in the epigastric region and right hypochondrium, less frequently in the left; a rapid and considerable loss of flesh; an accompanying anemia; a slight suggestion of jaundice; fat in the stools; slight bulging above the umbilicus, and rigid rectus muscles. The head of the pancreas can be felt hard and knobby, possibly tender and tumefied. When the stomach is inflated, the tumor vanishes. Sallis (*Revue de chir.*, April, 1914).

The factors which aid in the diagnosis of pancreatic lesions may be divided into 3 groups: (1) tumor, pain, tenderness, vomiting, cyanosis, and the signs of pressure upon neighboring structures; (2) failure of the external secretion of the pancreas, and (3) failure of the internal secretion of the pancreas. A mass, which is usually movable, may or may not be present in the upper abdomen in pancreatic disease. The pain is often very severe and may be continuous or paroxysmal. Vomiting and severe constipation are also prominent. Jaundice often aids in the diagnosis.

In drawing attention to the supposed relation between the thyroid gland and the pancreas, the author discusses *Locwi's test*. Two or three drops of 1:1000 solution of adrenalin are dropped into the conjunctival sac. If pupillary dilatation occurs in $\frac{1}{2}$ to 1 hour, pancreatic disease is probable. Of the various other tests for the failure of the external secretion of the pancreas, steatorrhea and creatorrhea are the most important. Failure of the internal secretion of the pancreas may be shown by the presence of glycosuria. The value of the Cammidge reaction is questionable. A. E. Garrod (Brit. Med. Jour., i, 459, 1920).

The voluminous stools referred to above are found to contain undigested muscle fibers (*azotorrhea*), which fail to be digested in the alimentary canal, owing to the deficiency of pancreatic juice caused by the lesions in the organ. Visible fat (*steatorrhea*) is also present, but as neutral fat, instead of as fatty acids and soaps into which fats are normally split by the pancreatic lipase. The large size of the stools is due to the passage of considerable food products which should have been absorbed through the intestinal canal. This accounts also for the rapid emaciation.

The examination of the feces is important. The typical, large, fatty, diarrheal stools to which the term steatorrhea is applied, is very strong evidence of insufficient pancreatic function. This typical stool, however, is present only in late and extensive disease of the organ. Constipation is the rule. Undigested muscle fibers (*azotorrhea*), if marked, possess some significance, though care must be exercised in interpreting this finding. The presence of an excess of neutral fat or of both neutral and split fats when sterco-

bilin can be shown chemically to be present in the feces is a point in favor of deficient pancreatic secretion. It is well to note that clay-colored stools do not mean absence of bile, since a large amount of unabsorbed fat and fatty acids will give the same appearance. If stercobilin can be demonstrated chemically it will prove that bile is being discharged into the intestine and that the chief source of the digestive disturbance is not the liver or its ducts, but the pancreas. Deaver (Jour. Amer. Med. Assoc., July 1, 1911).

DIAGNOSIS.—Chronic pancreatitis is at best difficult to identify. Cancer of the pancreas which presents much the same early history, cancer of the bile-ducts, perigastric adhesions due to gastric ulcer or cancer, are the principal sources of confusion.

Of considerable aid are *the methods for the detection of pancreatic insufficiency*, a condition which naturally follows lesions that reduce the functional activity of the pancreas such as is the case with chronic pancreatitis. The Cammidge reaction, once considerably employed, has been found unreliable; it is given here, however, for the benefit of observers who wish further to test its actual worth:—

Cammidge Test.—Cammidge abandoned his earlier "A" and "B" reactions, and published work on a new reaction, or "reaction C," which he thought gave accurate results in competent hands. Reaction "C," as described by E. H. Goodman (International Clinics, vol. ii, Nineteenth Series), is as follows:—

"A portion of the twenty-four hours' urine or a portion of the mixed night and morning specimens is examined for albumin and sugar. If albumin is present, it is removed by boiling with the addition of a few drops of acetic acid, and filtered. The removal of the sugar will be spoken of later. To 40 c.c. of the filtered, albumin-free, acid urine are added 2 c.c. of

concentrated hydrochloric acid, and the mixture gently boiled on the sand-bath for ten minutes following the first evidence of ebullition. A small flask with a funnel as condenser is used for the purpose. After ten minutes' boiling the flask is removed from the sand-bath, cooled in a stream of running water, and the contents made up to 40 c.c. with distilled water. Eight Gm. of lead carbonate are then added to neutralize the excess of acid, and after standing a few minutes the flask is again cooled in running water and the contents filtered through a moistened, close-grained filter paper.

"At this stage of the procedure, if sugar has been found on qualitative analysis, a portion of yeast is added to the clear filtrate, and the flask placed in the incubator over night. The next morning the solution is filtered and the test is continued.

"The acid filtrate is thoroughly shaken with 8 Gm. of tribasic lead acetate and the precipitate removed by repeated filtration through a well-moistened, close-grained filter paper. To get rid of the excess of lead, 4 Gm. of powdered sodium sulphate are added, the mixture heated on a wire gauze to the boiling point, cooled in running water to as low a temperature as possible, and the precipitate removed by careful filtration. Ten c.c. of the filtrate are put in a small flask, made to 17 c.c. with distilled water, and to this are added 0.8 Gm. of phenylhydrazin hydrochloride, 2 Gm. sodium acetate, and 1 c.c. of 50 per cent. acetic acid. The flask is then fitted with a funnel condenser and gently boiled on the sand-bath for ten minutes, at the expiration of which time it is filtered hot through a filter paper moistened with hot water. The filtrate if necessary is made up to 15 c.c. with hot distilled water, and the whole well stirred with a glass rod.

"In well-marked cases of pancreatic inflammation a light-yellow, flocculent precipitate should appear in a few hours, but in less characteristic cases it may be necessary to leave the preparation over night before a deposit occurs. Under the microscope the precipitate is seen to consist of long, light-yellow, flexible, hair-like crystals arranged in delicate sheaves, which, when irrigated with 33 per cent.

sulphuric acid, melt away and disappear in ten to fifteen seconds after the acid first touches them. The preparation must always be examined microscopically, as a small deposit may be easily overlooked with the naked eye, and it is also difficult to determine the exact nature of a slight precipitate by macroscopic investigation alone."

Far more reliable are the copper and the casein tests:—

Copper Test.—The simplicity, rapidity, and convenience of the copper test for pancreas functioning recommends it as stated by Ehrmann. It is based on the fact that a neutral fat, free from fat acids, is not split by anything but the fat-splitting ferment from the pancreas. Consequently, by addition of a stain which acts only on the fat acids, as they are split by the ferment, the presence of the latter is rendered evident. Commercial palmitin has proved the most suitable neutral fat for the test. The patient takes a test-breakfast of 30 Gm. of ordinary rice starch dissolved and warmed in a glass of water; a trace of salt is added and then 75 Gm. of palmitin, liquefied by heat, is stirred into it and the whole drunk from a glass. After two or two and a half hours the contents of the stomach are siphoned out and some is mixed in a test-tube with equal parts of a mixture of 90 parts petroleum benzin and benzol to 100 parts (Solution I). After the test-tube has been well shaken, the supernatant ether layer is decanted into a second test-tube and there mixed with an equal part of a 3 per cent. solution of copper acetate in distilled water (Solution II). The ethereal layer then assumes a bright-green tint in proportion to the content in fat acids. If none has been split off from the palmitin, owing to the absence of pancreas ferment, there is no color change in the fluid. The intensity of the change in tint is the index of the pancreatic ferment.

Casein Test.—Of all the diagnostic measures at our disposal according to Werzberg, the casein test for the presence of trypsin is the most reliable index of pancreas functioning. If casein is not digested by an extract of the stools, this testifies to lack of trypsin in the stool and

hence to insufficiency on the part of the pancreas.

Werzberg dissolves 0.2 Gm. sodium bicarbonate in 200 c.c. distilled water and heats to 50° or 60° C. (122° to 140° F.) and then stirs in 0.2 Gm. casein, boils the mixture for one minute and then filters. He pours 10 c.c. of this casein solution into each of five test-tubes and adds to each in turn 1 c.c., 0.8 c.c., 0.5 c.c., 0.3 c.c., or 0.1 c.c. of an extract of the stool obtained with a 1:1000 soda solution in a proportion of 1 to 10, filtering repeatedly until the extract is limpid. After the stool extract has been added to the casein solution in the test-tubes, he adds 0.5 c.c. chloroform, and when all has been well stirred he incubates the set of glasses at 37° C. (98.6° F.). On addition of 0.3 c.c. of a 1 per cent. solution of acetic acid to each tube the fluid remains limpid if the casein has been digested by the trypsin in the stool, while with lacking trypsin the undigested casein renders the fluid turbid.

While azotorrhea and steatorrhea were both marked features on admission of the case reported, the fat absorption was over 95 per cent. during the metabolism observations. The nitrogen absorption during a period without therapy averaged 55.8 per cent. While hydrochloric acid was given, the average was 47.6 per cent. During the feeding of pancreatin (not rhenania) 54.2 per cent. of the ingested nitrogen was absorbed. The nitrogen balance was normal during the metabolism work. Rapid improvement followed the administration of pancreatin (rhenania) and calcium carbonate. None of the other functional tests applied to the case gave significant results. From 4 liters of urine atypical "Cambridge crystals" were isolated. Barbour (Arch. of Internal Med., Nov. 15, 1911).

ETIOLOGY AND PATHOLOGY.

—Chronic pancreatitis usually occurs between the fortieth and sixtieth years. Sixty per cent. of the cases met with occur in the male sex, owing probably to the greater proportion of

individuals of this sex addicted to alcohol. The condition is comparable in many ways to hepatic cirrhosis or fibrosis. Induration of the *head* of the pancreas is the most noteworthy lesion, although the entire organ is sometimes involved.

The most frequent cause of chronic pancreatitis, according to Opie, is obstruction of the duct of Wirsung, due to pancreatic calculi, to biliary calculi in the terminal part of the common bile-duct, or to carcinoma invading the head or body of the gland. Duct obstruction may be followed by the invasion of bacteria, which take part in the production of the resulting lesion.

Ascending infection of the unobstructed duct of Wirsung may follow an acute lesion of the duodenum or of the bile-passages, and may cause chronic inflammation. In cases which have given a history of long-persistent vomiting, chronic diffuse pancreatitis may be found at autopsy, and is probably the result of an ascending infection of the gland. General or local tuberculosis is occasionally accompanied by chronic diffuse pancreatitis, affecting chiefly the interstitial tissue of the gland. Chronic interstitial pancreatitis is not infrequently dependent upon the same etiological factors, notably alcohol, which produce cirrhosis of the liver, and in about one-fourth of the cases the two lesions are associated.

Following duct-obstruction and ascending infection the lesion affects principally the interlobular tissue, only secondarily invading the lobular tissue and sparing the islands of Langerhans. Diabetes results only when the lesion is far advanced. Accompanying the so-called atrophic

or Laennec's cirrhosis of the liver, the pancreas is at times the seat of a diffuse chronic inflammation, characterized by diffuse proliferation of the interacinar tissue, which invades the islands of Langerhans. A similar lesion accompanies hyaline degeneration of the islands of Langerhans and the condition known as hemochromatosis. Interacinar pancreatitis is usually accompanied by diabetes mellitus. When diabetes is absent the lesion is of such slight intensity that the islands of Langerhans are little implicated.

Out of 6708 consecutive necropsies at Guy's Hospital, the pancreas has been described by the morbid anatomist as cirrhotic, congested, or hard in 26 instances; in 1 case it is described as like cartilage, and in those in which a microscopic examination was made an increase of fibrous tissue was found. This condition of pancreas was often associated with other evidence (for example, nutmeg liver) of severe backward pressure, and in 23 out of 26 cases there was such disease as would have caused severe backward pressure. In 2 of the cases the patient suffered from cirrhosis of the liver, and although then it is tempting to assume that the chronic pancreatitis was directly the result of venous congestion due to the cirrhosis, yet we must remember that some authors are decidedly of opinion that alcoholic drinks can produce chronic interstitial pancreatitis quite apart from cirrhosis of the liver. Kippel and Lefas, and Opie quote cases in point. W. Hale White (*Brit. Med. Jour.*, July 18, 1903).

The writer found evidences of chronic pancreatitis constantly in 27 male cadavers with a history of severe chronic alcoholism, including 15 men who had died during delirium tremens; all were free from cirrhosis of the liver. The changes in the pancreas were in the nature of intra-

lobular induration, but it was never so severe as when there was concomitant cirrhosis of the liver. Weichselbaum (*Wiener klin. Woch.*, Jan. 4, 1912).

TREATMENT.—The medicinal treatment is essentially dietetic, the aim being to reduce the quantity of articles of food requiring the pancreatic juice for their conversion. Hence the consumption of **fats** and **starches** should be **restricted**. Minced **animal pancreas** has been used with success; **pancreatin** (*q. v.*) is a more convenient remedy. Small doses of **sodium bicarbonate** twenty minutes after meals tend to allay the local pain.

Fles and Langdon-Down were among the first to use **pancreatic substance** or **pancreatin** in the treatment of serious cases of **steatorrhea**. In the first case described by the writer the fat in the stools of a glycosuric patient was equal to about 50 per cent. of the fatty input. The steatorrhea was promptly diminished upon the administration of pancreatic substance and of pancreatin-Aachen. During the period of treatment with these preparations N-resorption increased, while the elimination of fat was diminished to less than 20 per cent. of the quantity represented in the patient's diet. Recent investigations indicate that in diabetics the acetone bodies which appear in the urine are products of fat. In conformity with this theory the writer found that acetone elimination was relatively large in his patients during the periods when pancreatin was being administered and when the absorption of fats was relatively good. H. Salomon (*Berl. klin. Woch.*, Jan. 20, 1902).

Case of pancreatic disease which gave the clinical signs of colic, fatty stools, glycosuria, and imperfect proteid digestion. Various preparations were given the patient, including **pancreon**, **thyreoidin**, and **sodium bi-**

carbonate combined with pancreon and pancreatin. The best result was obtained from pancreatin with sodium bicarbonate. The thyroid preparation had a decidedly bad effect. Glaessner and Sigel (Berl. klin. Woch., April 25, 1904).

The diet in all cases of pancreatic insufficiency must be selected with care.

A loss or marked diminution in the amount of the pancreatic ferments seriously interferes with metabolism, even when there is partial compensation by the use of artificial preparations, but much may be done to mitigate this if the physiology of digestion and the results of experiments on animals deprived of their pancreas are borne in mind. It is advisable that the diet should contain a considerable proportion of **milk** and that other fats should be emulsified by the addition of **desiccated bile** or **soaps**. Solid fats, particularly those with a high melting point, should be avoided, as they are liable to undergo chemical changes in the intestine with the formation of irritating by-products and consequently give rise to discomfort. Cammidge (Lancet, June 3, 1911).

Surgical intervention is very beneficial, the incision being made when the head of the pancreas or the pancreatic duct is to be attacked, through the right rectus (Mayo Robson.)

The favorable influence of **simple laparotomy** is to be remembered. The benefit is probably the result of the active hyperemia, the drainage, removing the toxic products of the destructive process, etc. In chronic pancreatitis, recovery has repeatedly occurred after a laparotomy. **Drainage of the biliary passages** in case of gall-stones has a favorable indirect influence on chronic pancreatitis. Good results are more certain when the process is in an early stage than with cachexia, cholemia, etc. Walko (Archiv f. Verdauungs-Krankheiten, xiii, No. 5, 1907).

The relationship of pancreatic lymphangitis to the interlobular or interacinar varieties of pancreatitis has not as yet been clearly established. In the treatment of the former, drainage of the gall-bladder usually suffices. If the bile-ducts are diseased, the **common duct** should be **drained** as well. In more marked pancreatitis, particularly when the common duct is compressed, a **cholecystoduodenostomy** should be done if possible, together **with**, in some cases, **drainage of the common duct**; the latter step is the more important. The end results of chronic pancreatitis being comparable to those of interstitial nephritis and other like conditions, the operation should be performed early. J. B. Deaver (Arch. f. Diag., Jan., 1912).

In chronic pancreatitis, without jaundice and without evidence of back pressure on the biliary tract, the **gall-bladder** should be **removed** if it shows marked evidence of chronic inflammation, especially of the strawberry type. In this type the mucous membrane is covered with yellow specks which are the bases of the exposed villi stripped of their covering epithelium, with their connective tissue stained yellow by the bile. W. J. Mayo (Amer. Jour. Med. Sci., April, 1914).

The cause of the disease should be carefully sought and eliminated. Gall-stones are frequently causative; hence the value of operative measures, **drainage of the biliary ducts** being not only prophylactic but also curative.

When deep jaundice is present, **calcium chloride** in 20-grain (1.3 Gm.) doses should be given three times daily. Robson also gives it for twenty-four or forty-eight hours before operation and in the form of an enema for twenty-four hours afterward in 60-grain (4 Gm.) doses thrice daily.

CYSTS OF THE PANCREAS.—

Cysts of the pancreas have been divided by Mayo Robson into: (1) retention cysts; (2) proliferation cysts, or cystic adenoma or epithelioma; (3) hydatid cysts; (4) congenital cysts; (5) hemorrhagic cysts, and (6) pseudocysts. They most frequently develop from the tail, but vary greatly in situation and size.

SYMPTOMS.—The symptoms are influenced by the location and size of the cyst, but those of acute pancreatitis usually prevail; or there may be only disturbances of digestion and epigastric discomfort at first such as occur in chronic pancreatitis. The attention may be arrested by the discovery of a tumor, which may grow rapidly; in chronic cases it usually develops slowly. It may be subject to rapid enlargement from time to time, possibly on account of hemorrhage. The tumor is usually smooth and rounded, lying chiefly to the left of the middle line of the body.

In most cases the cyst grows in the lesser peritoneal cavity, pushes the stomach to the right, and develops between this organ and the transverse colon; sometimes it develops above the stomach, displacing this viscus downward, or below the colon, or, again, to the left in the splenic or nephritic region.

The cyst is only slightly movable and is not affected by respiration. It may transmit the aortic impulse, but it is not expansible. In large cysts fluctuation can sometimes be elicited.

Case of pancreatic cyst in which the patient had noticed a lump in the abdomen, which did not give rise to any symptoms until five days before admission, when she was seized with a sudden sharp colicky pain in the abdomen, in the region of the mass.

This lasted a short time, then subsided, and returned after a day and a half. Examination showed a large, slightly movable, spherical tumor, situated high in the abdominal cavity and not involving the uterus. Urine and blood examinations were negative. The tumor was supposed to be an ovarian cyst on a long pedicle, which had twisted, causing the pain. On opening the abdomen the tumor proved to be a large cyst about the size of a grape-fruit, free from adhesions except at its pedicle, which consisted of the head of the pancreas. B. C. Hirst and B. S. Veeder (Univ. of Penna. Med. Bull., May, 1910).

Contrary to the usual statement, benign pancreatic tumors are movable. Although the organ is retroperitoneal, it is invested by loose areolar tissue which permits considerable motion. The non-recognition of this has often led to errors in diagnosis. J. B. Deaver (Arch. of Diag., Jan., 1912).

Pancreatic and pseudopancreatic cysts, while not rare, are of sufficient importance to be recorded. The X-ray is an important aid in diagnosis in showing the position of the cyst in relation to the stomach and other organs. The treatment is surgical, usually incision and drainage. Sometimes it is practical to remove the entire cyst in favorable cases. Kerr (Surg., Gynec. and Obstet., July, 1918).

A cyst may grow until it distends the whole abdomen, extending from the ensiform cartilage to the pubes. If it projects into the left lumbar region, it renders it flat to percussion and resistant. By its pressure it may interfere with respiration and disturb digestion. Glycosuria is present in some cases. Azotorrhea and steatorrhea may also occur.

Neuralgic pains due to pressure on the neighboring nerves, jaundice from compression of the common bile-duct, pressure stenosis of the pylorus with

a resulting dilatation of the stomach, ascites, or intestinal hemorrhage from pressure on the mesenteric or portal veins, edema of the lower extremities from pressure on the vena cava, hydronephrosis from pressure on the ureters are all to be looked upon as possible complications. The cyst may rupture into the peritoneal cavity, the stomach, or intestine. This is followed by a watery fluid from the intestine and a sudden flattening of the abdomen.

DIAGNOSIS.—The following symptoms are of value in establishing a diagnosis of cysts of the pancreas: gastric symptoms, pain, tenderness, vomiting, signs of dilatation, etc.; emaciation; their development in the epigastrium, generally somewhat to the left side; their situation near the posterior abdominal wall, upon the aorta, so that its pulsation is seen and felt; their immobility; the fact that the stomach (dilated) and the transverse colon are found lying upon the cysts.

Pseudopancreatic cysts represent essentially a collection of fluid in the lesser peritoneal cavity and not a true cyst, and only resembles a pancreatic cyst in that the fluid sometimes contains the pancreatic ferments. In 4 traumatic cases each gave a history of severe abdominal pain with nausea and vomiting immediately following the accident. There was some fever, tenderness, and rigidity, which lasted until the tumor was recognized. The tumor can be made out in eight or ten days if carefully searched for and its appearance after an injury, protruding to the left above the umbilicus, together with the other symptoms mentioned rendered the diagnosis of fluid in the lesser peritoneal sac most probable. All the cases were treated by **incision and drainage**. F. A. Besley (Jour. Amer. Med. Assoc., March 28, 1914).

A persistent discharging sinus is in favor of a pancreatic cyst. Hydro-nephrosis, especially of the left kidney, and dropsy of the gall-bladder have to be excluded, as has also a large ovarian cyst. Distention of the lesser peritoneal cavity is often indistinguishable from pancreatic cyst.

As a rule, the content of the cyst consists of serous fluid, does not contain the digestive ferments, and does not reaccumulate after evacuation.

ETIOLOGY.—Pancreatic cysts occur equally in both sexes and usually in adult life, but are met with occasionally in young children. The largest group of cases results from inflammation of the gland or the duct. The tumor may develop rapidly, or may not appear for some weeks or even a year or two.

A second group of cases follow traumatic injury of the abdomen. Of 33 cases collected by Körte, 30 were in males. Probably many of them were due to accumulation of fluid in the lesser peritoneal cavity or to cystic formation in the vicinity of the gland. Doubtless some of them were due to inflammation of the gland or duct, causing occlusion of the latter and retention of secretion as in the first group. Some of them may have originated from hemorrhage into the pancreas.

In a third group there is no history of injury or of inflammation. These are met with in women especially, and run a very protracted course: some years usually.

Pancreatic cysts generally project forward between the stomach and transverse colon. In some cases, however, they appear above, the stomach pushing it downward, and in rare

cases they develop low down in the abdomen, both stomach and transverse colon lying above the tumor. Cysts are usually in the middle line of the body, but may lie to the left, near the spleen if developed from the tail of the pancreas.

The contents of cysts vary in character. Probably in smaller cysts the fluid is dark brown and contains blood or blood-pigment, fat-granules, degenerated epithelial cells, and, it may be, cholesterin. Large cysts are older and the contents are usually grayish, of alkaline reaction, and from 1010 to 1024 specific gravity. The fluid may not only emulsify fat and convert starch into glucose, but also digest albumin and fibrin. The last only is distinctive of the pancreatic origin of the fluid, as the contents of other cysts may possess diastatic and emulsifying power. It is also important to note that the fluid of pancreatic cysts in time loses digestive power (McPhedran).

TREATMENT.—Excepting in the smaller pancreatic cysts accidentally discovered which call for no treatment, **incision, drainage, or extirpation** should be resorted to. The incision is usually made in the median line of the abdomen, exceptionally over the most prominent part of the tumor. It is well to attach the cyst wall to the abdominal wall or to the parietal peritoneum before incising it. After emptying the cyst and **irrigating its cavity with saline solution**, a large glass drainage-tube should be introduced to the bottom of the cavity and surrounded by sterilized gauze. If the cyst is not extirpated, another tumor may subsequently develop. If drainage is resorted to, a fistula may result, which may give

rise to various complications, but in most cases the fistula will eventually heal.

TUMORS OF THE PANCREAS.

—Tumors of the pancreas are comparatively rare; while sarcoma and adenoma are occasionally met with, cancer is by far the most frequent and important.

Carcinoma.—This is more common in men than in women. The head is the usual seat, rarely the body and tail. The cancer is usually of the scirrhous variety, but cases of soft and of colloid growths are occasionally met with. Wirsung's duct is often obstructed and not infrequently the common bile-duct also, causing intense and persistent jaundice. By the size of the tumor or on account of implication of the wall of the intestine, it may cause obstruction of the duodenum. It occurs most frequently between the ages of 30 and 50, but may be met with at any age, even in infancy. Unlike cancer of the gall-bladder, it rarely occurs with calculi. It is usually primary, but the pancreas may be the seat of secondary metastatic tumors when the disease becomes generalized. Carcinoma of the stomach or duodenum rarely extends to the pancreas. It frequently extends by continuity to neighboring structures, and by metastasis to the adjoining lymph-nodes and to the liver.

SYMPTOMS.—These do not differ at first from those of chronic pancreatitis, and are seldom sufficiently distinctive to render a diagnosis possible. There is usually a long history of disturbed digestion. Of the disease itself there may be such suggestive symptoms as deep epigastric pain, which is often paroxysmal,

emaciation, and asthenia. Jaundice, which may develop suddenly or gradually and be intense, with enlargement of the gall-bladder, and ascites from pressure on the portal vein are also noted in most cases. There may be glycosuria, and undigested meat-fibers may appear in the stools as in chronic pancreatitis. As in this disease also, there may be duodenal and pyloric stenosis, with dilatation of the stomach, as a result of pressure. The most important symptom is the presence of a *fixed tumor*, in addition to extreme and persistent jaundice, due to obstruction of Vater's diverticulum, an enlarged gall-bladder, and the gradual development of cachexia and emaciation.

DIAGNOSIS.—Though rare, other tumors such as lymphomata, adenomata, and gummata are also met in the pancreas.

When the growth is sufficiently advanced the most suggestive signs are the epigastric pain, the immovable tumor, the intense jaundice with the ubiquitous signs of cancer, anemia, emaciation, and cachexia.

Syphilis more often causes diffuse interstitial infiltration. *Miliary tubercle* is not rare, Kudrewetski in 128 cases of tuberculosis found the pancreas tuberculous in 13, or in 9.37 per cent. The pancreatic disease seems to be always secondary, either by extension from neighboring organs or hematogenous in miliary tuberculosis.

TREATMENT.—When cancer of the pancreas is surely diagnosed operative treatment is either useless or harmful; when the diagnosis is doubtful, especially in young or middle-aged subjects, **exploratory operation** should be seriously considered,

since much may be hoped from surgical treatment in inflammatory conditions (Mayo Robson). On the whole, however, the outlook is, of course, hopeless, death occurring usually within a few weeks after the occurrence of the more grave symptoms.

PANCREATIC CALCULI.—Calculi are occasionally met with in the pancreatic duct similar to those occurring in the salivary glands or gall-bladder.

SYMPTOMS.—Calculi, when small or few, may produce no symptoms and are found unexpectedly at necropsies. When movable, however, they may awaken phenomena which have been termed "pancreatic colic."

The stone in its passage or incarceration may cause symptoms identical with those of gall-stone colic even to the jaundice, which, however, may be absent in both. Following severe paroxysms of pain in the epigastrium, calculi may be found in the stools, while, sometimes, transient glycosuria follows the attacks of colic. There may be symptoms of acute or chronic pancreatitis and cyst of the pancreas may form. There may be much muscle fiber in the stools, which may also be fatty. The patient may lose flesh and strength.

The diagnosis can only be deemed certain when calculi are found in the stools.

ETIOLOGY AND PATHOLOGY.—They are apt to occur between the ages of 35 and 45 years and are more common in men than in women. They are usually small, like grains of sand, but may be as large as a walnut, and are usually multiple. They are generally round, grayish white in color, and composed chiefly of calcium carbonate with some cal-

cium phosphate. Cholesterin has been found in some cases. They occur in dilated ducts or may be the cause of obstruction and dilatation of the ducts. They may excite chronic interstitial inflammation of the gland or acute suppurative inflammation. These may be followed by marked overgrowth of the fibroid connective tissue and atrophy of the glandular elements. Dilatation or great patency of the ducts or pseudocysts may be formed, which occasionally form fistula-like communications with the stomach or intestine. They may cause secondary infection and pancreatic abscess, and have been known to precede cancer of the pancreas.

TREATMENT.—The treatment is similar to that for biliary colic, **hot applications** to the abdomen, **morphine** and **atropine** hypodermically and **ether** or **chloroform anesthesia** if the pain is too intense to be controlled by the milder measures. The general treatment is that used for chronic pancreatitis.

Good results are reported from the hypodermic injection of 1 c.c. (16 minims) of a 1 per cent. solution of **pilocarpine**, three times a week.

When the stones are impacted, causing abscess formation or dilatation of the ducts, **surgical measures** are necessary.

In 293 cases of pancreatitis, stones were present in 77 per cent.; 52 per cent. in the gall-bladder, and 25 per cent. in the common duct. Cholecystitis was marked in 33 per cent. *per se* and plus other factors. In 3095 operations on the gall-bladder and biliary tract, 9.5 per cent. of the cases were accompanied by gross changes in the pancreas. In 394 operations in which stone was found in the common duct, 19 per cent. were accompanied by gross changes

in the pancreas. Pilcher (Annals of Surg., Jan., 1910).

Case in which a **calculus** was successfully **removed** from the pancreas, which was opened back of the duodenum. They have found only 133 cases of pancreatic lithiasis on record, including 16 in which operative treatment was applied. In their case röntgenoscopy later showed that the woman of 32 still has five very small calculi left in the pancreas. Although she feels well except for slight pain under the right costal arch, yet she is kept on a **diet free from meat and fat** in order to spare the pancreas as much as possible. In 5 of the 16 operative cases the stone could not be found and 3 of the patients died, as also 2 others requiring extremely complicated operations. The mortality was thus 34 per cent.; and 1 patient died several years later from pancreatic diabetes. Lacouture and Charbonnel (Revue de chir., July 10, 1914).

C. E. DE M. SAJOUS,
Philadelphia.

PANCREATIN.—Pancreatin (pancreatinum, U. S. P.; extract of pancreas, pancreatic extract) is a mixture of the enzymes existing in the pancreas of warm-blooded animals, usually obtained from the fresh pancreas of the hog. Pancreatin occurs as dry, whitish or yellowish-white, brittle scales, or oftener as a yellowish-white, amorphous powder without odor, or having a peculiar odor and a faint, meat-like taste. It is almost completely soluble in water, insoluble in alcohol, soluble in dilute alcohol, and is precipitated from solution by alcohol in excess. It is not an artificial compound. It should be absolutely free from all added substances and contain the ferments as they are naturally associated in the pancreatic glands. Five ferments are to be found in pancreatin: trypsin, which converts albumins or proteids (of milk, beef, fish, blood, etc.) into peptone in either neutral, alkaline, or slightly acid media; diastase, or amylopsin, which resembles ptyalin very closely and converts starches into dextrin and sugar;

an emulsive ferment which emulsifies the fats; steapsin, which splits fats into glycerin and fatty acids; and, finally, a milk-curdling ferment.

PHYSIOLOGICAL ACTION AND TESTS FOR PANCREATIN.—The value of a pancreatic preparation depends upon its digestive activity, and upon the quality of the resulting digested product. A pancreatic extract may peptonize milk perfectly, but the peptonized milk may be unfit for food, owing to the development of rancid fatty acids, giving the milk a peculiar, sour, repulsive odor. A good pancreatin should rapidly digest milk, beef, fibrin, and all forms of starchy food. It should convert the casein of milk into peptone without the development of any rancid flavor. The action upon casein may be taken as a satisfactory test of the proteolytic power of any pancreatin. The activity of a pancreatic preparation upon a proteid may be tested as follows: Place into a flask or bottle 15 grains (1 Gm.) of sodium bicarbonate, add 5 grains (0.3 Gm.) of dry pancreatic extract, or pancreatin; mix well and add 1 pint (500 c.c.) of milk warmed to 130° F. (54.4° C.). Shake well and place the bottle conveniently for observation. At first there should be no odor or taste imparted to the milk. In a few minutes the milk will become of a slightly grayish-yellow color which in ten minutes will be more marked, somewhat thinner, and of a distinctly bitter taste, due to the conversion of the casein. This taste is a pure bitter without suggestion of rancidity. For purpose of comparison, a second flask of milk mixed with the soda and water without the pancreatin may be prepared. By withdrawing a small portion of the milk from time to time and adding a few drops of acetic acid, the conversion of the casein may be tested by the character of the curd formed—from the tough casein, to the light, flocculent precipitate, and the final, slight, scarcely perceptible, granular coaguli. The diastasic power of a pancreatic preparation may be tested as follows: Mix 1 dram (4 Gm.) of arrow-root or starch with 5 fluidounces (150 c.c.) of cold water, and boil well. To a fluidounce (30 c.c.) of this thick starch (at 110° F.—43.3° C.) add a grain or two (0.06 to 0.13 Gm.) of pancreatin, or dry

pancreatic extract, or a few drops of a fluid product, and stir well. The starch should almost instantly become thin and fluid, like water, showing the formation of soluble starch, which is gradually converted into dextrin and glucose. A product which does not quickly liquefy thick, warm starch-jelly; worthless as a diastasic agent.

THERAPEUTICS.—Pancreatin is extensively used in the preparation of predigested or peptonized foods. It acts best in an alkaline medium, although the use of an alkali is not essential to the action of the pancreatic ferments. To peptonize food is to digest food artificially, to submit it to the action of the digestive ferments, whereby changes are effected precisely similar to those which in the living body are essential before it can be absorbed. Flesh and starch foods are incapable of being absorbed until by the action of the digestive juices they have become soluble. Pepsin is not available for household use in artificially digesting food of any kind. Peptonized food is, therefore, not food prepared with pepsin, or necessarily containing a ferment of any kind; it is digested food. The pancreatic ferments are capable of digesting every known form of food. The peptonizing action is most energetic at about the heat of the body, slow at the temperature of a room (60° to 70° F.—15.5° to 21.1° C.); at a lower temperature, even at freezing, the peptonizing agent is not destroyed, but is simply inactive; at the boiling point (212° F.—100° C.) it is at once destroyed. Peptonized foods are valuable in all cases where the digestive functions are impaired, during the course of **acute fevers**, and in **chronic wasting diseases**. They also fill a useful office during the period of **convalescence from acute and exhausting diseases**. They are therefore valuable in **typhoid fever**, **gastric ulcer**, **acute dysentery**, **chronic diarrhea**, **gastric catarrh**, **pneumonia**, **tuberculosis**, and **diabetes**. For infants, peptonized milk or milk prepared by Fairchild's peptogenic milk-powder or by means of Fairchild's extractum pancreatis or peptonizing tubes, is a valuable substitute for mothers' milk. When **rectal alimentation** is rendered necessary either from inability to swallow or from inability of the stomach to retain

or digest food, peptonized nutritive enemata become of inestimable value. These may be composed of milk alone or with egg, or egg-albumin, or of beef peptonized before being used.

J. E. McCracken has used pancreatin in cancer of the stomach involving the pancreas with rapidly diminishing body weight. In three weeks the patient had gained 2 pounds, the appetite and digestion improving meanwhile. Chronic membranous colitis, infantile atrophy, gastric ulcer and gastric neurasthenia were benefited in marked degree.

Pancreatic opotherapy is of great diagnostic value inasmuch as modifications of the quantity of proteids, fats, and carbohydrates in the stools following the administration of pancreatin indicates a pancreatic achylia. This diagnostic test may be applied in obstructions of the canal of Wirsung, gall-stones, cancer of the pancreas or cancer of the ampulla of Vater, and also in certain forms of acute and chronic pancreatitis.

Pancreatin, in doses of 3 to 10 grains (0.2 to 0.6 Gm.) in capsule, given about two hours after meals, and preceded by 10 to 15 grains (0.6 to 1 Gm.) of sodium bicarbonate, will assist insufficient salivary and intestinal digestion. It is also beneficial in nervous and lenteric diarrhea. In diabetes mellitus dependent upon a lesion of the pancreatic gland (carcinoma or atrophy) the use of pancreatin and of peptonized foods are strongly indicated.

In acute catarrhal benign pancreatitis, in chronic cystic pancreatitis, sclerolymphomatosis, in pancreatic infantilism and in pancreatic obesity and emaciation pancreatic opotherapy is of great value.

In diphtheria pancreatin has been used in spray and powder for the purpose of destroying the false membrane and favoring its expulsion. It is usually combined with sodium bicarbonate (3 parts to 1 of soda) for insufflation as a powder; or 15 grains (1 Gm.) of pancreatin and 5 grains (0.3 Gm.) of sodium bicarbonate, with a dram (4 c.c.) of glycerin in 1 ounce (30 c.c.) of water may be used as a spray. The latter should be prepared fresh every few hours. Samuel Johnson has suggested the addition of $\frac{1}{4}$ grain (0.015 Gm.) of corrosive sublimate. Better as a solvent

for diphtheritic membrane is the use of trypsin, as it presents the proteolytic ferment of the pancreas in the most active form. Trypsin may be applied by insufflation, pure or mixed with sodium bicarbonate—4 grains (0.25 Gm.) of trypsin to 1 grain (0.06 Gm.) of soda: it may be applied on a moistened brush or probe covered with absorbent cotton; or mixed with water and sprayed: trypsin, 15 grains (1 Gm.); sodium bicarbonate, 5 grains (0.3 Gm.); water, 1 ounce (30 c.c.): to be prepared fresh every few hours; chloroform or pure creosote, 4 drops, may be added as a preservative.

The proteolytic action of pancreatin has been utilized in the treatment of urethral and esophageal strictures, for dissolving sloughing tissue, coagulated blood, and mucopus. Pinkuss has used trypsin injections in a case of severe tuberculous adenitis of the neck, with markedly favorable results. He injected a tuberculous tumor with the same substance and obtained a rapid cure. C. D. Jones has used pancreatin or pancreatic extract for cleaning out ulcerous cavities in a case of hip-joint disease. A solution of 1 dram (4 Gm.) to the gill (120 c.c.) of water was poured into an abscess-cavity, remaining one week after an excision, left in place a half-hour, and the cavity then irrigated. In hemorrhage of the bladder, with the formation of clots, pancreatic extract in solution, with or without soda, may be used to dissolve the coagula. W.

PAPAIN, PAPAYOTIN, and PAPOID.—These are preparations of the juice of the fruit of *Carica papaya* (fam., Papayaceæ). The papaw or melon tree is a native of tropical America, where it is cultivated for its edible fruit, which in the green state is used for pickling, and when ripe as a dessert or hand-fruit, and for preserving. The juice is collected from incisions made in the fruit when nearly full-grown. The activity of its enzyme, though inhibited by alcohol, is less easily destroyed by glycerin, salicylic acid, etc., than is pepsin, and these have been used to preserve it. The dried juice is known as *papoid*. A large amount of the inert substance of papaya can be removed by extraction with

water and precipitation of the filtered extract by alcohol; this precipitate contains most of the digestive ferment and is known as *papain*, *papayotin*, or *caricin*, which is an enzyme similar to pepsin, but acting in alkaline, acid, or neutral solutions, occurs as a whitish, slightly hygroscopic powder, soluble in water or glycerin, but insoluble in alcohol, ether, or chloroform. It is given in doses of from 2 to 10 grains (0.12 to 0.6 Gm.), usually in combination with sodium bicarbonate.

THERAPEUTIC USES.—In 5 per cent. solution in equal parts of glycerin and water, it is used as a solvent of **diphtheritic and croupous membranes**. A 16 per cent. solution has been employed in **fissure of the tongue**.

Internally it has had large use in the treatment of **indigestion**, since it transforms proteids into peptones and albumoses by its proteolytic power, and has been found of value in both **gastric and intestinal indigestion**. It is slightly inferior to pepsin in the gastric form, and greatly inferior to pancreatin in intestinal indigestion. W.

PAPAVERINE. See OPIUM AND DERIVATIVES.

PARACENTESIS ABDOMINIS.

—Paracentesis (aspiration) of the heart, pericardium, and thorax is fully described in vols. iii and v. See INDEX. For paracentesis of the tunica vaginalis, see PENIS AND TESTICLES, DISEASES, and HYDROCELE.

Paracentesis of the abdomen consists in puncturing the peritoneal cavity by means of a trocar and cannula, and withdrawing the fluid abnormally present. The operation may be repeated many times and the danger is almost *nil*.

INDICATIONS.—In cases of **ascites** when the presence of fluid may be demonstrated, and the upper pressure against the diaphragm becomes excessive from the distention. Reaccumulation of the fluid after previous operation, giving rise to pressure symptoms, also indicates the procedure.

INSTRUMENTS, etc.—A cannula and trocar (straight or slightly curved), $\frac{1}{8}$ to

$\frac{1}{4}$ inch (3 to 6 mm.) in diameter, or, if preferred, a Dieulafoy or Potain aspirator, a scalpel, a sterile probe, a sterile abdominal binder, a many-tailed bandage or large towel, collodion, cotton, sterile gauze, and rubber adhesive plaster.

SITE OF PUNCTURE.—A location free from vessels and when the abdominal wall is thin is best. The favorite site is in the linea alba, midway between the umbilicus and the symphysis pubis, or at a point in the linea semilunaris, just outside the rectus muscle, on a line midway between the umbilicus and the antero-superior iliac spine. Repeated punctures usually entail a change of site so as to avoid entering the adhesions caused by previous punctures.

THE AMOUNT OF FLUID WITHDRAWN.—There is no harm, usually, in removing all the fluid, if done slowly. The condition of the patient and how he bears the operation will be determining factors.

POSITION OF PATIENT.—When the incision is in the linea alba, the patient should sit upright on the edge of the bed, or lie propped up in a semirecumbent position, in this way causing the fluid to gravitate to the bottom of the peritoneal cavity. The patient should lie on the side to be operated upon when the puncture is made in the linea semilunaris.

PREPARATION FOR OPERATION.—The bowels and bladder should be empty at the time of operation. The abdominal wall should be shaved and surgically disinfected, the trocar and cannula boiled, and the operator's hands thoroughly sterilized.

ANESTHESIA.—Local anesthesia with ethyl chloride, ether, ice and salt, or infiltration anesthesia with a few drops of a 0.2 per cent. cocaine solution is desirable.

TECHNIQUE.—A broad, sterilized abdominal binder, or many-tailed bandage, with a slit corresponding to the site of puncture is, after the site of puncture has been anesthetized, first fitted to the patient's abdomen and, later, tightened at intervals during the operation to give uniform support to the abdominal walls, and to prevent sudden overfilling of the abdominal blood-vessels and syncope. Through the slit in the bandage an incision ($\frac{1}{4}$

inch long) is made in the skin at the chosen site, and the trocar is slowly but firmly inserted, with the index finger at the side of the cannula as a guide to the depth of its entrance, and to guard against its going in too deep. The fluid should be withdrawn slowly and at intervals the finger should be placed over the end of the cannula to stop the flow and allow the abdominal contents to adjust themselves to the changed conditions. Sudden stoppage of the stream through occlusion of the cannula by intestines or omentum requires that the cannula be slightly turned or its position changed, or if necessary a sterile probe may be passed through it. As the fluid is withdrawn the bandage is gradually tightened to prevent syncope. If the latter occurs the end of the cannula should be closed with the finger, to prevent entrance of air, and the patient's head should be lowered.

When the fluid has been withdrawn, remove the cannula quickly, placing the finger-tip over the opening. If the latter is large a subcutaneous suture may be inserted and the skin drawn together. The line of incision, including the puncture, is then sealed with collodion, and a pledget of cotton applied over it. A sterile gauze pad, held in place with rubber adhesive plaster, may be necessary if there is much oozing of fluid. Twenty-four hours' rest in bed should always follow the operation.

W.

PARALDEHYDE.—Paraldehyde (paraldehydum, U. S. P.), $C_6H_{12}O_3$, is a polymeric form of ethyl aldehyde (acetic aldehyde, acetaldehyde). It is made by passing gaseous hydrochloric acid into aldehyde at ordinary temperature. When the liquor is no longer soluble in an equal volume of water, the conversion into paraldehyde is complete. The crude product is cooled to below $0^\circ C.$ ($32^\circ F.$), and the crystalline mass is carefully distilled. The process of freezing and distilling are repeated until the whole product volatilizes at $124^\circ C.$ ($255.2^\circ F.$). It should be kept in well-stoppered, dark amber-colored bottles, in a cool place.

Paraldehyde is a colorless, transparent liquid. It has a strong, characteristic, but not unpleasant nor pungent odor, and a

burning and cooling taste. It is soluble in alcohol, ether, oils, and chloroform, and in 8 volumes of water at $25^\circ C.$ ($77^\circ F.$), the latter solution becoming turbid when boiled. Paraldehyde is neutral, or has a faint acid reaction. The dose is from 30 to 90 minims (2 to 6 Gm.) given with an equal volume of sweet-almond oil in capsules, or well diluted with aromatic elixir, sweetened water, brandy, or rum.

PHYSIOLOGICAL ACTION.—Paraldehyde is a safe, pure hypnotic, resembling chloral in its action on the brain. In moderate doses, a natural sleep is speedily induced, which lasts from five to seven hours, without untoward after-effects (headache, weariness, etc.). The blood-pressure is lowered, but less than by chloral. It has no influence over pain, and for that reason should not be used as an hypnotic when pain is the cause of the insomnia. Continued use may impair digestion, cause diarrhea, and irritate the skin (cutaneous eruptions) and mucous membranes, particularly those of the nose, thorax, and abdomen. Paraldehyde, as shown by Gordon, is mainly eliminated by the lungs, being readily detected in the breath six or eight hours after its ingestion. In the urine it can also be recognized three or four hours after ingestion. The drug markedly increases the elimination of urea and also the watery constituents of the urine.

ACUTE POISONING BY PARALDEHYDE.—Toxic doses cause coma, muscular relaxation, lowered arterial pressure, and death from respiratory failure. In poisonous doses paraldehyde reduces the hemoglobin of the blood to methemoglobin. The clinical picture of poisoning by paraldehyde is characteristic: the patient is found in a deep stupor and limp, like one under the influence of chloroform, with a strong odor of the drug on his breath, face slightly flushed, pupils moderately contracted and quite insensible to light; pulse about 120 and weak; respirations may be as frequent as 40.

Treatment of Acute Poisoning.—The treatment of acute poisoning by paraldehyde is directed against the paralysis of the respiratory center. Respiratory stimulants, atropine, coffee, and electricity are indicated.

CHRONIC POISONING BY PARALDEHYDE.—Several cases of the paraldehyde habit are on record, and the results, both physical and mental, have usually been most wretched. Peterson, however, reported a case in which a woman took 1 ounce (30 Gm.) nightly for months, without ill effects—on the contrary, she became quite fat. Usually the patient becomes rapidly emaciated, has a feeling of great cardiac and general muscular weakness, and frequently suffers delusions of persecution and mental failure.

In a case reported by Hartz the objective symptoms were: restlessness, tremor, cyanotic condition of the hands, congestion of buccal mucosa; dry, coated, and fissured tongue, with fine tremor. There was marked evidence of existing arteriosclerosis. The insomnia was persistent and resistant to powerful hypnotics other than paraldehyde.

Krafft-Ebing, Fornaci, and Quarelli observe that symptoms resembling those of chronic alcoholism generally follow the long-continued use of the drug in large doses, and epileptoid convulsions are not infrequently observed.

THERAPEUTICS.—The chief use of paraldehyde is as an hypnotic and nervous sedative, but is *contraindicated* in cases of cyanosis with depression of the respiratory centers, as in the advanced stages of emphysema with cardiac dilatation. Care should be exercised if used in cases of insomnia attended by much physical or mental depression. Bright's disease, apparently, is not a contraindication to its use. For those who are taking iodides, paraldehyde should not be prescribed.

In the **sleeplessness of chronic alcoholism, chronic mania, and delirium tremens** paraldehyde is a valuable hypnotic.

In **spasmodic asthma, puerperal convulsions** and **irritative cough**, the drug is useful in small doses (30 minims—2 Gm.) repeated every half-hour for from 1 to 3 doses.

In **Cheyne-Stokes respiration** associated with **bronchopneumonia**, paraldehyde is very useful. Cevello found that 30 to 45 drops of paraldehyde at night, combined with the use of caffeine (4 to 8 grains—0.25 to 0.50 Gm. in divided doses during the day), by increasing the urinary secre-

tion, in cases of **edema, ascites, and pleuritic effusion**, was of material benefit.

Paraldehyde has been suggested as an antidote in strychnine poisoning.

INTRAVENOUS PARALDEHYDE ANESTHESIA.—Highly favorable results have been obtained from the use of paraldehyde administered intravenously as an hypnotic or **anesthetic for minor operations**. The hypnotic effect is induced very rapidly and is free from untoward effects, except a momentary depressant effect which may be avoided by combining with it an equal quantity of ether. From 5 to 15 c.c. of paraldehyde with an equal quantity of ether are mixed and dissolved in 150 c.c. of a cold 1 per cent. sterile saline solution. This is placed in a sterile bottle with a rubber cork through which pass two glass tubes, one reaching to the bottom of the solution and with a rubber tube armed at the distal end with a fine hypodermic needle for puncture of the vein; the other tube, ending above the surface of the solution, has a rubber bulb and tubing attached. The solution should be perfectly clear after shaking, and may be used cold or not exceeding 25° C. (77° F.). After filling the first tube, tubing, and needle to exclude all air, the needle is introduced within the median basilic vein. By pressure on the bulb the solution is very slowly introduced into the vein at the rate of 5 to 10 c.c. per minute. In five seconds the patient tastes formaldehyde; in ten seconds it can be detected in the breath; in twenty seconds a sensation of general warmth with dizziness or a sense of floating is felt; in thirty seconds consciousness begins to disappear; in forty seconds unconsciousness is complete; in sixty seconds there is profound unconsciousness; in ninety seconds corneal reflex is absent and anesthesia is complete. As elimination is very rapid through the lungs, the entire amount of the solution will be required for a prolonged effect. Consciousness is restored in twenty minutes after stopping the infusion, and no untoward after-effects have been observed.

If preferred, the solution may be introduced by gravity. Grave cardiac or pulmonary disease is said not to contraindicate the use of this method, which has

been used with perfect success in these cases for its hypnotic action. Alcoholics, acute and chronic, come under its influence more rapidly. W.

PARALYSIS AGITANS. See TREMOR.

PARASITES, DISEASES DUE TO.—INTESTINAL PARASITES.

—Parasites which infest the human intestinal tract may be divided into (1) nematodes, or round-worms; (2) trematodes, or sucking-worms; and (3) cestodes, or tape-worms.

NEMATODES (Round-worms).—All round-worms occurring as parasites in man belong to the order of Nematodes. They have long, slender bodies of simple outline, without segments or appendages. They are usually bisexual and provided with alimentary organs. The males are usually smaller than the females. Some nematodes as found in the human intestines are quite harmless, but others are more dangerous; a few pass into more sensitive tissues and organs, producing disturbance or even dangerous injuries.

Ascaris lumbricoides, the common round-worm, is in color a yellowish or reddish brown, cylindrical in shape, and tapering at the ends, marked with fine transverse striæ, and characterized by four longitudinal ridges running their entire length, somewhat similar in appearance and shape to the earth-worm. The female is from 20 to 40 cm. in length; the male is smaller, about 20 cm. in length and provided on its posterior extremity with a bend like a hook, carrying two projections or processes. The cephalic extremity of both male and female has three oval papillæ furnished with fine teeth. The sexual

organs occupy the posterior half of the body, the sexual opening being at the junction of its anterior and middle thirds. The female produces an enormous number of eggs, which, when fully developed, possess a double shell, around which is an albuminous envelope. They are about 0.05 to 0.06 mm. long, elliptic and dark reddish in color. These are found almost anywhere in the intestinal canal, but chiefly in the small intestine, and are very resistant to external influences. These ova mature and develop into the round-worm in the intestine, requiring no intermediate host. They attain sexual maturity in from ten to twelve weeks after the eggs have been swallowed, at which time the length of the female is 20 to 30 cm. and that of the male 13 to 15 cm. Infection occurs through the ingestion of ova in food or drinking-water. Usually not more than one or two are present, but they may occur in enormous numbers.

Symptoms.—The presence of the round-worm only rarely produces any symptoms in its host; even then they are often most obscure. In children, however, it sometimes causes a variety of forms of intestinal irritation, which tends to precipitate nervous disturbances. Peiper and others suggest that these nervous symptoms are caused by an irritating toxin, derived from the round-worm. Chauffard, Marie, and Tauchon describe a condition called *typholumbricosis* as due to this substance. This is a complex of fever, colicky pain, nausea, vomiting, indigestion, restlessness, irritability, anorexia, itching of and picking at the nose, disturbed sleep with grinding of the teeth, salivation, nervous twitchings, foul breath, and inter-

mittent diarrhea, which continues for a month or more (Osler), and sometimes is accompanied by prolonged coma (Voucka), or follicular enteritis (Concetti). These parasites, as shown by Thermais, often act as the basis of neurasthenic, hysteriform, epileptiform, and choreiform disorders, and occurring usually in subjects offering no neuropathic antecedents.

There can be no doubt concerning the importance of an examination of the feces, for ova, in all obscure cases presenting reflex neuroses, as very nervous children may show convulsions, choreic movements, dilated pupils, vertigo, cephalalgia, mental disturbances, and even contractures.

The round-worm occasionally finds its way into the normal or abnormal openings in the surface of the intestinal canal, and thus produces mechanical disturbances. They are sometimes found in the feces, and are occasionally ejected from the mouth while vomiting. They have also been known to obstruct the common gall-duct, enter the larynx and Eustachian tube, causing asphyxia; pulmonary gangrene, perforation of the membrum tympani, hepatic abscess, or other more or less grave disturbances.

Complications.—Jaundice may develop, due to obstruction of the bile-ducts. Intestinal obstruction may occur if the worms are numerous. Perineal abscesses and inflamed herniæ that have perforated externally sometimes discharge the *Ascaris lumbricoides*.

Treatment.—It should be remembered that before giving any anthelmintic the intestinal tract should be free of food for from twenty-four to thirty-six hours so that the drug

may act directly upon the unprotected worm.

For the removal of the lumbricoid worms nothing has been found to equal **santonin**, which, if judiciously used, is almost always satisfactory. It must be borne in mind that very considerable ill-effects have followed the excessive or prolonged use of this drug, not only xanthopsia, but hebetude or torpor, and in some instances death. Coppola calls attention to the fact that as a result of the catarrhal condition produced by the parasite a large amount of lactic acid is sometimes found in the intestines, which favors the solution of santonin and its consequent absorption. He, therefore, prefers the use of **santoninoxim**, in double or triple doses, as equally active, but less absorbable and non-toxic. Santoninoxim is a crystalline powder obtained by Cannizaro from santonin by an alcoholic solution of hydroxylamine hydrochloride and calcium carbonate.

The dose of santonin should not be above $\frac{1}{6}$ to $\frac{1}{2}$ grain (0.01 to 0.03 Gm.) if frequently repeated, or 1 to $1\frac{1}{2}$ grains (0.06 to 0.1 Gm.) a day in children from 1 to 6 years of age (Demmi).

An adult may be given 2 to 4 grains (0.13 to 0.26 Gm.) of santonin in a troche before breakfast for two or three days, followed by a brisk purge, preferably calomel, or the **santonin** and **calomel** may be given in combination. A good rule is to give to a child of from 2 to 4 years from $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.016 to 0.03 Gm.) of santonin along with the same amount of calomel, and after a very light supper composed of one-half glass of milk, each night, for three successive nights.

The writer has met 11 cases in which an **operation** was required for evil done by ascarides. In 6 cases these were in the open abdominal cavity; in 3 there was ileus from obstruction by them; they had perforated the intestine in one case, and in another they had caused adhesions and volvulus. In one case as the abdomen was opened the appendix was suddenly stretched out to nearly twice its length by an ascaris within. It is safer to make no attempt to remove the helminths at the laparotomy. Repugnant as it is to leave them alive, the successful outcome in the writer's cases confirms the wisdom of doing so and trusting to santonin to expel them later; 117 were thus voided in one of his cases and 489 in another. Schloessmann (Beiträge z. klin. Chir., xc, No. 3, 1914).

Naphthalin is recommended by Engel: from $\frac{1}{3}$ to $1\frac{1}{2}$ grains (0.02 to 0.1 Gm.), four times a day, for three days. **Oil of chenopodium** in doses of from 5 to 10 drops in emulsion, capsules, or on sugar is also useful. Some use the unofficial **fluid-extract of spigelia and senna** in from 1- to 3- dram (4 to 12 c.c.) doses.

The writer prefers the officinal **oleum chenopodii** to the less reliable santonin. In proper doses, the oil will act with certainty and toxic symptoms do not occur. The urine turns a distinct yellow which changes to red after the addition of soda lye. Occasionally there is slight headache with nausea, but never any albumin or sugar in the urine. The writer recommends the following prescriptions:—

℞ *Ol. chenopodii anthelmintici* .. ℥xvj (1 c.c.).
Mentholis gr. iij (0.2 Gm.).
 M. dent. tal. dos. vi ad caps. gelat.
 Sig.: Every two hours one capsule for 3 doses on two successive days, during the morning in hot coffee and milk.

℞ *Ol. ricini* ʒii $\frac{1}{3}$ (70 Gm.).

Sig.: Two tablespoonfuls two hours after the third capsule on each day.

The menthol acts as corrective and prevents nausea. For oxyuris, the oil has not proven so satisfactory. M. Glockel (Münch. med. Woch., Aug. 2, 1910).

Where santonin is not well borne or ineffective, and in older children, a combination of **oil of chenopodium and menthol** is useful:—

℞ *Olei chenopodii* .. ℥x (0.6 Gm.).
Mentholis gr. iss (0.1 Gm.).
 M. Divide in capsulas no. vi.

The doses given are suitable for a child 10 years old. Three capsules should be administered at intervals of two hours on two successive days, and $\frac{1}{2}$ ounce (15 c.c.) of **castor oil** given in addition on the second day. Railliet (Bull méd., April 17, 1912).

OXYURIS VERMICULARIS

(*Ascaris vermicularis*), the seat-worm, thread-worm, pin-worm, also called the awl-tail, maw-worm, maggot, is a small, whitish round-worm which in man sometimes infests the large intestine and the lower part of the small intestine. They may frequently be found as high as the cecum and have even been seen in the stomach and mouth. The length of the female is 10 mm. and pointed at the caudal end like an awl; the male is 4 mm. in length with a blunt posterior extremity provided with a spiculum. Leucart claims they are incapable of multiplying *in situ*; for development the ova must be swallowed. The eggs are brought forth by the female in enormous numbers, and are only developed in the intestinal tract of man or beast. They are about 0.05 mm. in length and develop into oxyures in about two weeks after they are ingested. These eggs are very

vigorous and offer marked resistance to external agencies.

The favorite habitat of these worms is the rectum, where the female lays immense numbers of eggs that mature and are discharged with the feces. The worms frequently crawl out of the anus and in females may enter the vagina and cause vulvovaginitis, pruritus, and leucorrhea. Infection with the ova may take place through food and water or from the hands of infected persons.

Symptoms.—The symptoms of the thread-worms are itching of the anus, usually worse at night, accompanied by disturbed sleep and extreme irritability; burning pain, tenesmus, frequent micturition, restlessness, anorexia, and anemia are frequent symptoms. Chorea and convulsions may be occasionally caused. The irritation resulting from the presence of the parasite may also be the cause of masturbation in both sexes, and prolapsus ani.

Diagnosis.—The diagnosis is easily made by exploring the rectum and finding the oxyures or by examination of the feces for the worms or their ova aided by the microscope.

Treatment.—In the treatment of thread-worms (*Oxyuris vermicularis*) very little has been offered in recent literature that bears the stamp of novelty. Scrupulous **cleanliness** is the first essential. The parts about the anus, especially after each stool, should be bathed with a 1:10,000 **bichloride of mercury** solution. The most important points are the mechanical and chemical cleansing of the lower bowel and the use of such drugs by the mouth as are known to paralyze or destroy the worms. The indications are summed up by San-

som: first, to expel the intruders and all their ova by the use of simple **aperients**, kept up for several weeks, along with **enteroclysis of pure water**, which causes the parasites to swell up and burst; second, to prevent the entrance of ova into the digestive tract by the use only of **food and drink** which have been **thoroughly cooked**.

Preventive measures, among infected children, are of great importance (Nicholson), such as keeping the **nails short and clean**, **dipping them** frequently into **quassia**, and enforcing **isolation** until a cure is effected. For the intestinal irrigation plain water suffices, if used repeatedly and for a long-enough period, which is daily for a week or two or twice a week for five or six weeks. Holt regards injections of **bichloride of mercury** as the most efficient. The colon should be first thoroughly cleansed by a solution of lukewarm water containing 1 dram (4 Gm.) of **borax** to the pint (500 c.c.). After this is discharged half a pint of a 1:10,000 solution of bichloride of mercury should be injected into the bowel high up through a catheter and retained as long as possible. The **infusion of quassia** (1 to 2 ounces—30 to 60 Gm.—of the powder or chips to a pint—500 c.c.—of water) enjoys an especial reputation in this connection, and is the remedy which we have mostly used, from three to five irrigations, on consecutive days, usually sufficing; in obstinate cases, where the infection reaches very high up, more may be required. **Carbolic acid**, **turpentine**, **tannin**, **vinegar**, **camphor**, **potassium sulphide** and **oil of eucalyptus** may also be employed in rectal irrigations.

Solutions of Castile soap are recommended by Monti, continued for from one to three weeks. A. Gremand regards **sulphur-water** as the most satisfactory, *per clyisma* as well as *per os*. W. N. King recommends a saturated aqueous solution of **socotrine aloes**, 1 ounce (30 Gm.) of which is injected into the bowel at bedtime and retained, and this should be repeated for several consecutive nights; it is then discontinued, and, upon a return of the parasite, is again used. Engel recommends a **bichloride solution** 1:2000, but this agent should be most cautiously used.

For internal administration the first item to be considered is **diet**. The addition of **garlic** to the food enjoys a very ancient reputation.

Of drugs, the most important are those which act as laxatives, aromatics, and intestinal antiseptics. Sidney Martin recommends a **mixture of rhubarb, carbonate of magnesia, and ginger** in small doses. Ashford recommends **betanaphthol** in 2-dram (8 Gm.) doses. The larval forms may be destroyed by the administration daily for five days of **methylen-blue** in doses of from 18 to 24 grains (1.2 to 1.5 Gm.) per day. This treatment is given three times, ten days apart.

For the relief of the anal pruritus **mercurial ointment** is useful; it serves the double purpose of soothing the parts and preventing the escape of the worms from the bowel. **Injections of laudanum and starch-water** (3 to 5 drops to the ounce—30 c.c.), **carbolyzed vaselin**, and **belladonna ointment** are useful in allaying rectal irritation.

The best way of treating *Oxyuris vermicularis* is by the application of

an ointment consisting of **camphor, quinine, and thymol** (vermiculin), on and about the anus after it has been thoroughly cleansed with soap and water. The procedure is repeated after each defecation. Personal cleanliness is carefully attended to, nails and fingers being thoroughly cleansed before each meal. These regulations are carried out for two or three weeks. No irritation has been noticed from the use of the ointment. B. Hildbrand (Münch. med. Woch., Jan. 21, 1913).

It must be borne in mind that frequently the removal of these apparently trifling parasites is attended with the greatest difficulty, especially when there is considerable catarrhal inflammation of the colon. It is most essential in applying the irrigations that they be given thoroughly and in such a way, in obstinate cases, that they reach, if possible, the cecum. The injection should be given through a long catheter or rectal tube, which must be cautiously inserted well up beyond the sigmoid flexure, the child lying on its left side, for five minutes, then on its right side for five minutes,—preferably a much greater period. When the worms are high in the colon, in addition to injections, drugs by mouth, such as **saline cathartics** and simple bitters, especially **quassia** and **gentian**, should be given.

Having recommended **bismuth carbonate** to 2 patients with gastric and duodenal ulcer, and obtained unexpected effects in completely freeing them of pinworms which had resisted all previous measures, the writer used it regularly in treatment of oxyuriasis, giving adults on 2 successive days, 10 Gm. (2½ drams); children of 7, 4 Gm. (1 dram), and under this age, only 2 or 3 Gm. (30 or 45 grains), and has found it effectual even in families where parents

and children were all affected. In 4 or 5 days the parasites and ova disappear from the stools, or a second or third course may be required. Loeper (Prog. méd., July 31, 1920).

Loeper's method of using **bismuth carbonate** in expelling oxyurids used by the writer in a rebellious case in a woman of 22. After a week of strict **milk diet**, 5 Gm. (1¼ drams) of **bismuth carbonate** were taken morning and evening in a glass of water for 3 days. This was followed by a **purge** and **local mercurial salve**. The course was repeated a month later without dieting, but followed by a **calomel purge**, and the patient has been permanently relieved. Barrio (Arch. Españ. de Pediat., Jan., 1921).

ASCARIS ALATA (*Belascaris mystax*) is a nematode sometimes found in the intestines of the dog and cat and occasionally in man. The female is about 6 to 7 cm. and the male about 4 cm. long. The head has a wing-like projection on either side, the body is slender, and the tail is closely rolled in a spiral.

TRICHOCEPHALUS DISPAR (*Ascaris trichiura*), or whip-worm, is an entirely harmless, but quite common, intestinal parasite frequently found in the cecum, and occasionally in the colon.

The size of male and female are similar: from 4 to 5 cm. in length. The forepart of the body is narrow and the afterpart much thicker, giving it the appearance of a whip. The sexual organs are in the thicker portion, and in the posterior end is a spiculum. In the male this end is spirally coiled. The eggs are elongated and oval in shape, have a peculiar button-like protuberance at each end, resemble diminutive lemons, and are 0.55 mm. long; they possess a thick, brown shell, at each pole of which is

a clear, globular mass. They develop slowly and first in water and damp earth, and are very resistant to cold and dryness. The trichocephalus occurs in Europeans more frequently than in Americans. It is found also in the domestic animals.

It rarely, if ever, produces any symptoms, even when occurring in enormous numbers, though some claim it sucks blood and causes anemia.

TRICHINA SPIRALIS, an intestinal parasite of the rat, dog, cat, hog, and man, occurs in two forms: the trichina of the intestines and the trichina of the muscles—phases of their development. Sexual maturity is reached in the intestines, where it appears as a small, white, hair-like worm, the female 3 mm. in length, the male much smaller, 0.8 to 1.5 mm., readily visible to the naked eye. In shape it is long and narrow, the intestinal canal beginning with a muscular mouth acting as an intestine. The organ increases in caliber, passes down into the food-canal, and is surrounded throughout its length by a row of large cell-bodies. The eggs develop into embryos within the uterus and are set free at birth.

The embryo, or muscle trichina, which is from 0.6 to 1 mm. in length, lies coiled up in an ovoid capsule, which is at first translucent, but later becomes opaque and infiltrated with lime-salts.

When trichinous flesh is eaten by man or by certain animals the capsules are digested in the stomach and the trichinae liberated. Passing into the small intestine they become sexually mature in from two to four days, when they produce innumerable embryos. The intestinal trichinae

usually die in four to five weeks, after the females have produced several broods of embryos. These embryos leave the intestines for the muscles, the mode of transmission being, according to J. Y. Graham, through the blood-stream. About two weeks after reaching the muscle they attain the larval form. The irritation caused by their presence results in an interstitial myositis and the formation of a fibrous capsule. As a rule, the capsule is occupied by only one worm, but occasionally two or three are seen together. The trichinæ may thus live for years in the muscles. According to Osler, the dissecting-room and post-mortem statistics show that from $\frac{1}{2}$ to 2 per cent. of all bodies contain trichinæ. Of 1000 consecutive autopsies of which he has notes, trichinæ were present in 6 instances. About 900 cases have been reported in the United States in the past forty-five years (Beecher). It is more frequent in European countries. The eating of improperly cooked pork furnishes the greatest cause of this disease in man. Recent investigations show the fatty as well as the muscular parts of pork may contain live trichinæ. Solmon's report shows that about 2 per cent. of American hogs are infected.

Symptoms.—If only a small number of trichinæ are swallowed, no symptoms follow; but, in case of a large dose, gastrointestinal symptoms—consisting of loss of appetite, vomiting, pains in the abdomen, and diarrhea—develop within a few days. The diarrhea may resemble that of cholera, or there may be obstinate constipation. Bodily fatigue and muscular weariness are present before the evidence of myositis. When

the embryos begin to invade the muscles, which occurs between the seventh and fourteenth days, there are usually chills and fever. Myositis is present and is characterized by stiffness, tension, and pain on pressure and movement. The flexors of the extremities are particularly sore and contracted, sometimes causing acute flexion of the elbows and knees. There may be difficulty in mastication, phonation, and deglutition, and an intense and distressing dyspnea may add to the suffering. The temperature shows remissions usually and may be subnormal. The pulse corresponds to the temperature. Edema, seen early in the face, is noted in almost all the cases, and may be intermittent. Ascites may occur. Laryngeal edema and bronchial catarrh often increase the dyspnea. Pleurisy or pneumonia may be present. Profuse sweating, miliaria, itching and tingling of the skin, acne, urticaria, furunculosis, and herpes may occur. In protracted cases, especially, anemia and emaciation are often great. Such nervous symptoms as dilatation of the pupils, insomnia, loss of tendon-reflexes and headache have been noted. Osler has noticed a marked leucocytosis, which may reach above 30,000, and may prove of value in forming a diagnosis. Eosinophilia, sometimes amounting to as high as 68 per cent., is usually noted but may be absent in very severe cases. Albumin and casts may be found in the urine.

Pathology.—The diaphragm is most thickly infested with the larval trichinæ. Next in order are the intercostals, abdominal muscles, muscles of the neck, larynx, head, eyes, and extremities. Microscopically the mus-

cles show the changes of acute myositis. The trichinous cysts in the muscles macroscopically appear as small, grayish-white, opaque, oat-shaped specks, longitudinally arranged in the muscle fibers.

Diagnosis.—In addition to the above-mentioned symptoms, the stools may afford important information. They should be examined with a low-power lens, under which the trichinæ appear as small, silvery threads. The diagnosis, when doubtful, may be confirmed by obtaining a piece of muscle from the biceps by a small instrument called a harpoon.

Acute rheumatism sometimes resembles this disease, but the joint swelling in the one and the great increase in the eosinophiles in the other will aid in separating them. *Cholera*, *acute polymyositis*, and *typhoid fever* may also simulate trichiniasis, and must be carefully differentiated.

Prognosis.—The prognosis should be guarded, since it greatly depends upon the number of trichinæ swallowed, and upon the number of embryos generated in the intestines. A favorable symptom is early diarrhea.

Treatment.—As a *prophylactic* measure, **care** should be taken with regard to the feeding of hogs to prevent this infection, the **destruction of rats** about styies, and **rigid inspection of the meat-supply**. **Thorough cooking** should always be insisted upon when pork is utilized as an article of diet.

As soon as it has been discovered that trichinous meat has been eaten, some purgative, of which **calomel** followed by a **saline** is the most useful, should be given. **Senna**, **aloin**, **rhubarb**, or **glycerin** may be tried. Some

anthelmintic, such as **male fern**, **santonin**, or **thymol**, should be used in conjunction with the purgative. **Turpentine** may be used in full doses. For the muscular pains, **hot baths** and **anodyne applications** sometimes afford relief, while the **bromides** may secure the much-needed sleep. The patient's strength is to be maintained by easily assimilable, **nutritious food**, and stimulants, such as **strychnine**, **peptonoids**, etc. During convalescence **massage**, **electricity**, and **local applications** will aid in removing the muscular soreness and stiffness.

There is no known drug that will kill the parasite, but the treatment now recommended is an initial purge, preferably **castor oil** or **calomel**, followed by **Epsom salts** in doses of from $\frac{1}{2}$ to 1 teaspoonful daily. **Thymol** in 5-grain (0.3 Gm.) doses three times a day is given as an intestinal antiseptic. If the muscular pain is severe **opiates** may be used. M. Seymour (Jour. Amer. Med. Assoc., April 8, 1911).

THE HOOK-WORM.—Ankylostoma or Agchylostoma.

The hook-worm belongs to the class of Nematodes; family, Strongylidæ. It is a common parasite of the intestines, where it causes a disease variously called: hook-worm disease, ankylostomiasis, uncinariasis, dochmiosis, Egyptian or tropical chlorosis, tunnelworkers' disease, brickmakers' disease, miners' anemia, mountain cachexia, ankylostomanemia, mal de cour, negro consumption, tun-tun, and many other names.

Historical Sketch.—Cases of this disease were described as early as 1648, but the cause was unknown. The first hook-worms were discovered in 1782 and 1789. In 1838 Dubini described the worm, gave to

it the name of agchylostoma, and attributed to it certain pathological lesions, but no special disease. Griesinger in 1854 emphasized the relation of this parasite to "Egyptian chlorosis." Similar reports were made later by Brazilian and Italian physicians, who proved it to be the cause of brickmakers', miners', and tunnelworkers' anemia.

Grassi and Parona established the diagnostic test of finding the ova in the feces in 1877.

It was soon found that hook-worm disease existed in nearly all European countries. Joseph Pitt (1808) is probably the earliest author to refer to the disease in this country, though he was ignorant of the cause and believed it to be due to the habit of negroes eating dirt, and this was the belief of other physicians of his and later times. In 1901 Dr. Allen J. Smith found hook-worm ova in the feces of a plantation overseer in Texas, and discovered that the worms expelled from the patient were different from the European hook-worm. In 1902 Stiles described the new species, gave it the name of *Uncinaria americana* or *Necator americanus*, and declared the existence of an endemic of hook-worm in the United States. Looss in 1898, at Cairo, Egypt, discovered that infection occurred by the larvæ penetrating the skin.

Geographical Distribution.—"Hook-worm disease belts the earth in a zone about 66 degrees wide, extending from parallel 36 degrees north to parallel 30 degrees south." (Publication No. 61—"The Rockefeller Sanitary Commission for the Eradication of Hook-worm Disease.") The following is a list of the reported infected countries:—

AFRICA.—Algeria, British East Africa, Zanzibar, Egypt, Gold Coast Colony, Lagos, Natal, Sierra Leone, Tunis.

SOUTH AMERICA.—Antigua, Argentina, Barbados, Brazil, British Guiana, British Honduras, Colombia, the Dominican Republic, Ecuador, French Guiana, Guatemala, Jamaica, Honduras, Martinique, Nicaragua, Panama, Paraguay, Peru, Porto Rico, Salvador, Dutch Guiana, Trinidad, Venezuela.

NORTH AMERICA.—The United States from Virginia to Florida and Texas; Mexico.

ASIA.—Bagdad, Ceylon, China, India, Japan, Java, Korea, Malay States, Philippine Islands, Samoa, Straits Settlements, Sumatra, Australia.

EUROPE.—Austria, Belgium, Bulgaria, France, Germany, Italy, Netherlands, Spain, Switzerland, Wales.

Climate.—The worms are most prevalent where the temperature ranges between 78° and 95° F. (25.5° and 35° C.), and a moist, sandy soil makes the best incubator.

ANKYLOSTOMA DUODENALE (Dubini, 1838).—**Synonyms.**—*Strongylus quadridentatus* (von Siebold, 1851); *Dochmius anchylostomum* (Molin, 1860); *Sclerostoma duodenale* (Cobbold); *Strongylus duodenale* (Schneider, 1866); *Dochmius duodenalis* (Leuckart, 1876 *pro parte*). Old World hook-worm.

Description.—In shape this hook-worm is almost cylindrical, the male being about 10 mm. long by 0.45 mm. wide, the female 12 to 13 mm. long by 0.60 mm. wide. The anterior end tapers in both sexes to a fine point. The posterior end of the male widens out into a fan-like form, or bursa, giving it a square appearance.

The color when alive is nearly flesh-red, or cream; when dead, gray or grayish white. The posterior two-thirds is very often red or reddish brown, due to blood in the alimentary canal. The skin is smooth, showing fine transverse striations. Four to eight longitudinal bands run the length of the body. A membranous septum attached dorsoventrally divides the body cavity and supports the alimentary canal.

The alimentary system consists of a mouth and its appendages, esophagus, and a straight canal which extends to the posterior end, having an independent anus in the female, but terminating in a cloaca with the sexual apparatus in the male.

The mouth, on account of the dorsal bend of the body, opens toward the back and the rim is nearly parallel with the long axis of the body. It is semioval, or cup-shaped, the bottom of the oral cavity being flat, uneven, and nearly transverse. A flexible plate gives rigidity and outline to the rim of the mouth. Just within the mouth-cavity on the ventral side are two pairs of sharp-pointed, curved, hook-like teeth; at the base of the cavity on the ventral side are two triangular, pointed teeth or "lancets," and on the front of the dorsal side are two tooth-like bodies separated by a fissure. The lining of the mouth-cavity is thrown into six papillary prominences. In the middle of the dorsal wall the duct of the dorsal esophageal gland opens. From the ventral teeth the two cervical glands extend to nearly the middle of the body.

The triangular esophagus begins at the base of the oral cavity and extends to the gut, at the junction with which is a trilobed valve. Three

nerves run along the esophageal grooves in relation to the three esophageal glands which open into the buccal cavity. At about the middle of the esophagus, on each side, is a small papilla where the duct of the cervical gland opens.

On each side of the anus in both sexes are several "anal glands" which open into the intestine.

The sexual opening of the female is at the posterior third of the body. A short vaginal tube divides into an anterior and posterior uterus, each one being continuous with a narrow ovary lying in transverse folds along the intestine. Ova in great numbers and in different stages of segmentation are seen within the uterus.

The male sexual glands consist of a long, folded tube on each side of the intestine. They reach forward as far as the cervical glands and open into a seminal vesicle situated about the middle of the body. An ejaculatory duct leads from the seminal vesicle to the cloaca, which opens in a papilla within the ventral side of the tail bursa. A "cement gland" covers the duct and elaborates the secretion which fastens the worms during copulation. At the opening of the duct a forked process extends toward the tail and from the opening two long, slender "spicules" extend outward.

The bursa, or umbrella-like expansion of the posterior end, is supported by extensions of the muscular body wall called rays. The bursa and its muscular rays enable the male to firmly grasp the body of the female in copulation.

The ova are 0.056 to 0.061 mm. long by 0.034 to 0.038 mm. wide, oval in shape, with rounded poles. In

fresh stools the ova are usually in four segments and separated by a space from their enveloping shells.

They are similar in appearance to, but smaller than, the eggs of *Ascaris lumbricoides*. The first stages of their cleavage take place in the human intestine, and if the ova are voided so that other human beings may receive them (which is chiefly through the drinking of muddy

hook-worm just described. It is almost as long, but is more slender, the male measuring 7 to 9 mm. and the female 9 to 12.6 mm. The mouth-capsule is small and rounded and the orifice more quadrate than oval. No teeth exist on the free edge, but a broad dorsal and a ventral lip extend inward to or beyond the edge of the membranous lip, forming the margin of the buccal cavity. Two cutting



Greatly enlarged lateral view of the male hook-worm (*Necator americanus*). (Stiles.)
U. S. Public Health Bulletin, No. 32.



Greatly enlarged lateral view of the female hook-worm (*Necator americanus*). (Stiles.)
U. S. Public Health Bulletin, No. 32.

water, where they develop still further), they develop into complete sexual maturity in their final host.

The natural habitat of this parasite is in the upper part of the small intestine.

NECATOR AMERICANUS (Stiles, 1902).—**Synonyms.**—*Uncinaria americana* (Stiles, 1902); *Ankylostoma americanum* (von Linstow, 1903); *Dochmius duodenalis* (R. Leuckart *pro parte*); New World hook-worm.

Description.—This New World hook-worm is regarded as a different species from that of the Old World

plates are found beneath these lips. There are two pairs of ventral teeth and a blunt, conical dorsal tooth projecting from the buccal cavity. The duct of the esophageal gland passes through the dorsal tooth, and at its base are two chitinous plates. The bursa has very long sides and the female genital opening is anterior to the middle of the body. The ova resembles those of the *Ankylostoma duodenale* closely, but are somewhat larger and more tapering.

Development of the Hook-worm.—The female parasites lay their eggs in the intestine of the host and

they are expelled with the feces. Under proper conditions of moisture, warmth, and oxygen the eggs hatch and the larvæ escape from the shells and feed on the feces. Five moults are passed through during the development of the larvæ before it becomes an adult worm. After the second ecdysis they are "ripe," growth and feeding cease, and they become infectious. At this stage they attempt to get into moist earth, wood, or water, and have a strong tendency to migrate or crawl upon near objects, such as sticks, grass, etc. At this stage they are very resistant to germicides, heat, and cold, and will live a long time if moisture and oxygen is supplied. They possess a wonderful ability to penetrate the skin, to which they can attach themselves even after a short contact. The skin of the foot in bare-footed persons is most frequently attacked, though the buttocks of children who go around in their "shirt tails," ankles, hands, and arms are frequently the sites of infection. The larvæ burrow through the skin, causing a dermatitis which is variously called "water sore," "ground itch," "dew poison," "toe itch," and other names. After entering the subcutaneous tissues they enter capillaries and are carried to the heart. From the heart they pass to the lungs, where they penetrate the capillaries and enter the bronchial tubes. Thence they pass to the mouth and are spit out or swallowed. Their development is then the same as larvæ taken directly into the stomach through food, water, etc. They pass through the stomach uninjured by the gastric juice and into the intestine, where in four or five days be-

gins another ecdysis, during which they acquire a buccal capsule. By means of this capsule the worm fastens itself to the mucosa, from which it derives its nourishment. In four or five days more the last ecdysis begins, the last skin is shed, and the worms, now about one-fifth of an inch long, grow rapidly, and in about six to eight weeks begin to lay eggs.

Symptoms.—The symptoms depend upon the number of worms present and are due to loss of blood and to the absorption of a toxin elaborated by the worms.

The anemia may be so mild in slight infections that it passes unnoticed. In mild infections there are usually indigestion, tenderness, pain and discomfort in the epigastrium, usually of long standing. In children growth is retarded and adolescence is delayed. In severe infections in males the beard fails to grow and in women menstruation is delayed, irregular, scanty, or absent.

The hemoglobin is decreased and may range from nearly normal percentage to as low as 8 per cent. Eosinophilia is common, ranging from 5 to 72 per cent. or more. The erythrocytes in severe cases fall as low as 2,500,000 to 3,000,000 per c.mm. They are paler than normal and stippling is generally found. Normoblasts are often present, but megaloblasts are rare. Poikilocytosis and polychromatophilia occur when the anemia is severe, also anisocytosis. Leucocytosis is not marked. Marked anemia is usually accompanied by albuminuria and dropsy.

The skin is tinged a dirty yellow, is pallid and lacks the normal amount of perspiration. A dermatitis occurs where the larvæ penetrate the skin.

There is at first itching, swelling, and redness. In twenty-four to thirty-six hours vesicles appear and if numerous may become confluent. Pustulation follows vesiculation in about twenty-four to forty-eight hours. Lymphangitis may occur in severe cases and wrinkling of the skin is a prominent feature in long-standing or severe cases.

Except in mild cases, precarious appetite, gastralgia, meteorism, dyspnea on exertion, headache, lassitude, mental torpor, nausea, vomiting, and coated tongue are invariably present. The appetite may be perverted and the infected subjects will crave dirt, charcoal, ashes, coffee-grounds, etc. Palpitation is a frequent symptom and may be severe. A hemic murmur and hypertrophy of the heart may occur. The pulse is rapid and compressible. Pain in the sternum and chest, weakness of the legs and knees, dizziness, tinnitus aurium, pains in the muscles and joints are common.

In marked cases there is edema of the feet and ankles or of the whole body. Bulimia and geophagy are seen. Diarrhea may be present or alternate with constipation. Pulsation of the jugulars or large veins, precordial pain, insomnia, paresthesias, dilatation of the pupils, blurred vision, impotence in males and amenorrhea in females are frequent symptoms. The patellar reflex is often abolished and subnormal or irregular temperature may intervene. Cough, bronchitis, and sore throat are usually present in severe cases for the first ten days after infection. Dyspnea is one of the most common symptoms, especially with a low hemoglobin percentage. Edema of

the lungs and hydrothorax are likely symptoms in severe cases.

Diagnosis.—A tentative diagnosis can usually be made from the history of the dermatitis combined with symptoms of anemia, underdevelopment, weakness, lassitude, and heart symptoms. An eosinophile count is also useful. A positive diagnosis is made by finding the ova in the feces.



Dwarfing effect of the hook-worm. These boys are brothers. No. 1, age 17, weighs 156 pounds; light infection. No. 2, age 18, weighs 74 pounds; heavy infection. (Rockefeller Sanitary Commission Report 1911.)

There is no operculum as in the ovum of the oxyuris.

Pathology.—The principal lesions in ankylostomiasis are ulcerations of the intestines, principally in the duodenum and jejunum, and changes in other organs and parts due to anemia and toxemia.

Treatment. — **PROPHYLAXIS.** — This should consist of measures to prevent infection by exterminating the

mature worms in human beings, and also checking the supply of ova to prevent the growth and existence of larvæ and to prevent infection by larvæ.

Cases of mild or no symptoms—**hook-worm carriers**—should be sought out by boards of health in infected communities, **isolated and treated until cured**. The primary source of infection is the feces. **Stools should be protected from flies and other carriers and disinfected** as scrupulously as in typhoid-fever cases. This would prevent the growth and development of larvæ. To prevent infection by the larvæ, **education of infected communities** on the subject is helpful. **Skin infection** is the most serious danger and persons should be **warned against** exposing the feet or other parts to **contamination** by infected soil, water, etc. They should **not soil the mouth nor eat with muddy hands, should not eat muddy fruit or vegetables, should not drink muddy water or water from muddy receptacles**. In short, they should **avoid handling or using anything contaminated by infected earth or water**. **Earth-eating should be rigorously prohibited** and the **water-supply be made pure**.

In the districts in which this disease occurs, all **drinking-water** should be thoroughly **boiled** and **latrines** should be systematically **employed**.

ACTIVE TREATMENT.—For the dermatitis, the **vesicles** should be **opened, washed, and dressed** with some soothing, antiseptic preparation daily. The patient should be urged to spit out everything coughed up for several days to prevent swallowing possible larvæ.

No treatment is known which will

kill larvæ in the body and prevent them from maturing into worms.

Before vermifuges are given the intestinal canal should be emptied as thoroughly as possible to remove mucus and foreign matter which would protect the worms from the action of drugs. **Rochelle, Epsom, or Glauber's salts, calomel, podophyllin, jalap, senna** are recommended, **sodium sulphate** probably being the best.

After the purging, the most universally used drug for the destruction of the hook-worm is **thymol**. This is given in amounts varying from 10 to 150 grains (0.6 to 10 Gm.) per day, usually in divided doses, finely powdered, in capsules. For children the dose should be in proportion to the age. After three or four hours another purge is given to sweep out the excess of thymol to prevent absorption. Oils should never be used for this purpose, as thymol is soluble in oils and enough may be absorbed to cause harmful results. The patient should **remain in bed** while taking the treatment and should receive **no nourishment** except water until one or two bowel movements have occurred after the last purge. The treatment may be repeated in a week.

Stiles approves of 60 grains (4 Gm.) as the standard dose of **thymol** in the adult. **Magnesium sulphate** is given in the evening, one-half the dose of thymol next morning at 6 A.M., the remaining half at 8 A.M., and salts again at 10 A.M.

Oil of chenopodium has more recently been recommended as superior to thymol. Three successive 8-minim (0.5 c.c.) doses are given.

Beta-naphthol may be used in place of thymol. The dose is 30 grains (2 Gm.) for an adult. It is less depress-

ing than thymol, costs one-tenth as much, but is more irritating to the kidneys and may cause dizziness.

Oleoresin aspidii is used in ankylostomiasis by some practitioners. "**Duhourgou's téniafuge français**" is: *Ext. filix-mas*, 4 Gm. (1 dram); *chloroform*, 3 Gm. (45 grains); *ol. ricini*, 40 Gm. (1½ ounces). This is given in two doses with one hour's interval and repeated the next day. This drug is variable in its effects, is costly, causes more dizziness and nausea, and makes patients feel sicker and weaker than does thymol. The dose should not exceed 75 to 150 grains (5 to 10 Gm.) of the oleoresin given in two divided doses one hour apart.

Oil of eucalyptus in doses of 1.25 c.c. (19 minims) combined with **chloroform** and **castor oil** is useful in bringing away the worms alive.

Podophyllin, **oil of peppermint**, **kerosene oil**, **guaiacol carbonate**, and other drugs are mentioned as being useful.

The anemia and other symptoms should receive appropriate treatment.

FILARIA.—The *Filaria sanguinis hominis* includes a number of varieties, but the three principal ones are the *Filaria sanguinis hominis nocturna*, *Filaria sanguinis hominis diurna*, and the *Filaria perstans*.

The *Filaria nocturna* is the most common form, the male measuring 83 mm. in length and the female 155 mm. From the lymphatics, where the adult forms are only found (*Filaria bancrofti*), it matures and brings forth its young, which reaches the blood-current, and are called *Filaria nocturna*. Here it is found only during the night, or, as Stephen Mackenzie has noted, in the daytime when the patient is a day-sleeper.

The embryo, which is about the diameter of a red blood-corpuscle, may be present in the blood-vessels in large numbers without causing any symptoms, but the adult worms or ova are apt to block the lymph-channels, producing lymph-scrotum, elephantiasis, or hematochyluria.

The mosquito, by sucking the blood from a person with this disease, is probably connected with the further development of the embryos. It is most likely that some change takes place within the mosquito, which, upon dying, sets free the embryos in some stagnant water, where still further development occurs; this, however, has not been proved. Man probably becomes affected through the drinking-water.

Symptoms.—In hematochyluria the urine passed is white, opaque, and milky, or sometimes bloody, with a sediment consisting of a slightly reddish clot. The patient may be troubled with this condition only intermittently, normal urine being passed for weeks between the attacks. Fat-granules, red corpuscles, and the embryos in the urine are found microscopically. Manson attributes some at least of the cases of elephantiasis arabum to the effects of the filariæ.

In lymph-scrotum, another condition caused by this parasite, the parts are very much swelled and thickened. The lymph-vessels are so distended that they are plainly visible and exude a turbid fluid upon puncture.

Treatment.—When filariasis exists, all **drinking-water** should be **filtered or boiled and kept away from mosquitoes**. In cases of chyluria the diet should be dry and devoid of fat. **Thymol** and **methylene-blue** have

both been claimed by different observers to have given good results.

Manson contends, however, that the attempt to cure filaria chyluria by the administration of a parasiticide is founded on a misconception of the true pathology of this disease and the part played by the filaria in its production. The filaria stands to chyluria very much in the same relation as rheumatic fever stands to heart disease and gonorrhea to urethral stricture; it starts the pathological process, but its constant presence is not necessary to keep it up. To attempt, therefore, to cure chyluria by trying to kill the filaria is illogical. Once established in the human body, the filaria should be left alone,—protected, rather than persecuted. Pathology indicates that the proper treatment is in principle the same as acquired varix in any inaccessible region. This should be **rest, elevation**, lowering of the tension in the lymphatic vessels by the use of **saline purgatives, limited and appropriate food, and abstinence from fluids** as much as possible.

Surgical intervention is sometimes of value in removing the adult filariæ from the enlarged lymph-glands.

FILARIA, OR DRACUNCULUS, MEDINENSIS,—or **persarum** or **guinea-worm**,—is a thin, thread-like worm from 60 to 100 cm. in length, of which the female alone is known. The cephalic end is rounded off, while the caudal end tapers to a point. The external covering consists of a firm cuticle; the uterus filled with young occupies the chief part of the body cavity. The embryos have no shell, but merely a thick covering, with a pointed tail. These embryos are received into the human stomach

through the intermediation of small crustacea and are swallowed through drinking-water. Probably both male and female are ingested, the male dying after the female is impregnated. After impregnation the female penetrates the intestine and reaches the subcutaneous tissues, where she may remain quiescent for a long time and can be felt beneath the skin. The worm contains immense numbers of embryos, which, when ready for discharge, are ejected as a whitish fluid through an ulcerated opening made by the head of the worm, usually near the foot or ankle. The worm spontaneously leaves the host after parturition and care should be taken not to tear it. It may be removed by rolling it around a piece of wood, gradually, day by day. If the embryos reach the water they develop into cyclops and men are infected by drinking these larvæ. It is frequently found among the inhabitants of Asia and Africa, developing in the skin, occasioning abscess chiefly in the lower extremities, especially about the heel.

Treatment.—The symptoms produced by the dracunculus are chiefly local and little can be expected from internal medication. Oriental practitioners, however, secure excellent results from the internal use of **asa-fetida** for a week or more; **nitrate of potash**, in 2-dram (8 Gm.) doses in **buttermilk**, and the use of **sugar-candy** exclusively is said to cause the death of the worm in one or two days (R. Atmaran).

It may be **excised** entire or killed by **injections of bichloride of mercury** (1:1000). **Amarpattee** leaves are regarded as almost a specific.

Local measures and **surgical inter-**

ference are chiefly relied upon by many observers. One of the simplest is the use of **cold-water affusion**. J. C. H. Peacocke recommends the plan of placing the limb under an interrupted stream of water as soon as the worm has made its external opening in the skin.

Other non-important filaria are: *Filaria loa*, about 3 cm. long, found in West Africa, Brazil, and the West Indies. Its habitat is beneath the conjunctiva. The *Filaria lentis* is sometimes found in cataracts. The *Filaria labialis* has been found in a pustule of the upper lip. The *Filaria hominis oris* has been found in the mouth. A filaria found occasionally in the trachea and bronchi and even in the bronchioles and lungs is called the *Filaria bronchialis*. The *Filaria immitis* is the common *Filaria sanguinis* of the dog and has been found in man. Female worms have been found in the portal vein and ova in the bladder wall and uterus.

EUSTRONGYLUS GIGAS (*Diocetophyme gigas*) is a rare parasite found occasionally in the pelvis of the human kidney, which organ may be entirely destroyed. The urine shows blood and eustrongylus ova. The female reaches the length of a meter. It is cylindrical, and red or brownish in color. The anterior end is retracted, the mouth surrounded by six papillæ. The posterior end is expanded and a spicule projects from the cloaca. Several species of the dochmius occur also in dogs and cats, horses and cattle, and also produce anemia. Certain varieties of strongylus occur as intestinal parasites or in the lungs, blood-vessels, or other tissues in the domestic animals.

ANGUILLULA INTESTINALIS ET STERCORALIS (*Pseudorhab-*

ditis stercoralis, *Strongyloides intestinalis*, or *Rhabdonema intestinale*) is a small nematode found in Italy, Cochinchina, and along the Gulf of Mexico. In Italy it sometimes co-exists with the *Ankylostomum*, but produces little harm except an occasional diarrhea, anemia when present in large numbers. The parasite penetrates the crypts of Lieberkühn, where it deposits its eggs and young, causing disturbances of the epithelium. They are also found in the biliary and pancreatic ducts.

ACANTHOCEPHALA (Thorn-headed Worms—*Gigantorhynchus gigas*; *Echinorhynchus hominis*).—This is a common parasite of the hog and is sometimes found in man. It is of large size and has as its intermediate host the cockchafer grub and in America the June bug.

TREMATODES (Sucking-worms).—The trematodes include a varied group, consisting usually of flattened elliptic organisms that attach themselves to certain structures and derive their sustenance by sucking. They are usually hermaphroditic, and their developmental cycle requires the sojourn of the embryo in an intermediate host. When fully developed, they are found, with but few exceptions, in vertebrate animals. The first host is usually a mollusk.

The *Distoma hepaticum*, or liver-leech, is a leaf-shaped sucking-worm, 28 mm. in length and 12 mm. in width. Five species of liver-flukes are known to occur in man, viz.: (1) *Fasciola hepatica* (common liver-fluke); (2) *Dicrocoelium lanceatum*; (3) *Opisthorchis felinus*; (4) *Opisthorchis noverca*—*Distoma conjunctum*; (5) *Opisthorchis* (*Distoma*) *sinensis*. The first and last are the most important. The

worm is flattened, elliptic, with a small head provided with a sucker at the end. A second sucker is found on the ventral surface immediately behind the neck. The sexual opening is between the two suckers. The uterus makes up the chief part of the body and consists of a central tube and lateral branches. The testicular organ consists of a delicate series of coils. The eggs are ovoid in shape, 0.13 mm. in length, and 0.08 mm. in width, from which an embryo develops in water and attaches itself to a host of the mollusk family. Leuckart says the young of the liver-leech are protected by the limnæa in marshes in the form of radiæ or germ-sacks, in which appear later on germ-granules. From these are developed cercariæ, resembling tadpoles. When these are taken into the digestive tract of ruminant animals, or, as rarely happens, into man, they enter the bile-ducts and sometimes the intestine or inferior vena cava. When these parasites are present in animals,—which sometimes occurs and in great numbers,—the bile-ducts are obstructed, ulcerative strictures or dilatation is produced, bile-concretions are formed, and inflammatory changes are established in adjacent structures or changes produced in the parenchyma or glandular tissues. The endemic fluke disease occurring in Japan is characterized by hepatic enlargement, emaciation, diarrhea, and, frequently, ascites. The prognosis is fatal and treatment merely palliative.

The *Distoma lanceolatum* likewise occupies the biliary passages in sheep and cattle, where it occurs in small numbers and occasions no important changes; if in greater numbers, dis-

turbances are produced in the structures of the liver. It is very rare in man.

The *Distoma hæmatobia*, *Bilharzia hæmatobia*, or blood-fluke, is very common among the inhabitants of Egypt, one-fourth of whom are said to suffer from its effects; it also occurs in Zanzibar, Cape Colony, Syria, and Sicily. The male is from 12 to 14 mm. in length, and is stouter and larger than the female, and the body surface is rough and irregular; the female, 16 to 19 mm. in length, is more slender and smoother than the male. They lie, as a rule, in close contact, the female in the *canalis gynecophorus* of the male. Both sexes live in the portal, abdominal, and cystic veins. The eggs are of an elongated oval, 0.12 mm. in length, with a terminal or lateral spine. The embryos are cylindrical, with conically pointed posterior ends and elongated snouts anteriorly. They are ciliated and motile.

Small crustaceans act as the intermediary host into which the ciliated embryo bores its way and becomes capsulated. Infection probably occurs through drinking water containing the larvæ, and through the skin of bathers. The parasites are found in the portal vein and its branches, the splenic and mesenteric veins, and in the blood-vessels of the bladder and rectum. The eggs, traversing the mucosa and sub-mucosa, reach at times the liver, lungs, kidneys, as well as the bladder and rectum, giving rise to irritation, ulceration, concretions, and neoplasms. The first and most constant symptom is hematuria, which gradually leads to anemia. Cystitis often occurs, and proctitis, with mucous and bloody stools and tenesmus, may result from lodgement of the parasites in the rectum. There is slight

leucocytosis, with increased percentage of eosinophiles and large mononuclears.

As to treatment, the extract of **male fern** internally is considered of value by Fouquet. Prophylaxis consists in **boiling the drinking-water** and **abstinence of bathing in infected water**.

The *Distoma pulmonale*, *Paragonimus westermani*, or bronchial fluke, is a club-shaped parasite about 8 to 10 mm. in length. It is found encysted usually two in each cyst, with eggs. The general arrangement of the suckers and genital opening is similar to the liver-fluke. Eggs are produced in large numbers and discharged from the lung in the sputum. Infection in man occurs from the ingestion of encysted forms or as free-swimming embryos. The eggs are operculated, dark-brown, thick-shelled and vary from 80 to 100 micra in length by 40 to 60 micra in breadth. The intermediate host is not positively known, but is probably a water snail. It is found in China, Japan, and Formosa, where, according to Ringer and Manson, it causes an epidemic disease. It has also been found in hogs in sections of the United States, and in tigers, dogs, and cats. It is located primarily in the lung, its presence resulting in cough, hemoptysis, and the occurrence of small flukes in the expectoration, which will differentiate it from pulmonary tuberculosis, for which it is often mistaken. There is no special medicinal treatment. Prophylactic measures should be established as to the drinking-water and care of the sputum.

The *Fasciolopsis (Distomum) buski*, the *Mesogonimus heterophyes*, and the *Gastrodiscus (Amphistomum) hominis* are occasionally found as human intestinal parasites.

Schistosoma japonicum vel *cattoi* is the name given to a parasite inhabiting the vessels of the intestine of some of the inhabitants of China, Japan, and the Philippine Islands. It causes a disease characterized by progressive anemia, cirrhosis of the liver, ascites, splenomegaly, dysentery, cystitis, and occasionally localized epilepsy. In Japan it is called the "Katayama" disease. The treatment is symptomatic.

CESTODES (Tape-worms).—Cestodes are flat worms about the size and color of a fragment of white tape, devoid of mouth or intestine. They increase by alternate generation, through the germination of a pear-shaped primary host (scolex, or head), and remain attached to it for some time as a long, band-shaped colony. The sexually active members of this colony, or proglottides, increase in size the farther they are separated from their place of origin, by the formation of new members, but they have no other outward peculiarity.

Each proglottis is in itself a complete sexual animal, containing a large branched uterus, ovaries and testicular structures with vasa deferentia. The sexual opening is at the side of each proglottis in the tenia and at the inferior edge in the bothrioccephali. Each segment when ripe contains thousands of eggs, some of which pass into the feces and some pass out with detached segments. The eggs when eaten by an appropriate host develop into embryos in the intestine and from there pass to the voluntary muscles or other tissues, where they develop into larvæ or cysticerci (scolex) inside of cysts.

The pear-shaped primary host (scolex, or head) has from two to

four suckers, and is provided also with claw-like, curved hooks. By means of these adhering organs the tape-worms fasten themselves to the intestinal wall of their immediate host, which is always one of the vertebrate animals. The scolices develop from a round embryo with four to six hooks, and are found as so-called "measles," chiefly in parenchymatous organs. Later by means of passive migration they move out of these organs into the intestine of their future host.

Tape-worms which occur as parasites in man belong to different families known as (1) the *teniæ* and (2) the *bothriocephali*.

Tenia Solium (Pork Tape-worm).—The hosts for this parasite are the hog and man. When fully developed this worm is from 2 to 3 meters in length. Its head is spherical, the size of a pinhead, with a projecting rostellum armed with a double row of hooklets, and has four permanent sucking-cups. The crown of the head is often pigmented. Next comes a filiform neck about 1 cm. long. A division into segments commences at a certain distance from the head, of which there may be 200 to 450. The first segments are short, but their length increases from before backward. They are first square, then longer than they are wide.

The mature segments begin about 130 cm. behind the head. The sexual organs are fully developed in the earlier segments. The mature segments when stretched are from 9 to 11 mm. long, and from 6 to 7 mm. wide, with rounded corners.

The parenchyma of the body of both mature and immature tape-worm segments is divided into two chief

layers, viz.: (1) central, or middle, layer; (2) peripheral, or cortical, layer.

The middle layer includes the sexual organs, also an excretory apparatus that traverses the whole tape-worm from the head to the last segment in the form of two canals. The canals are connected at the posterior end of each segment and send subdividing branches to the parenchyma.

The sexual apparatus consists of male and female sexual organs lying close together. The germ-preparing organs consist of a double ovary and a single albuminous gland. When the eggs enter the uterus from the globular body in which the first stage of development occurs, the lateral branches sprout forth and become filled with eggs. The eggs in the ovary are pale-yellow, globular cells. In the uterus they become yellowish balls with a thick, opaque shell. This shell frequently has a second envelope, and in it are imbedded nuclei. These thick-shelled balls are no longer eggs, but contain an embryo with six hooklets. While still in the uterus, development of the embryo takes place, and the segments are here impregnated. The eggs, when ripe, measure about 0.03 mm. in diameter, are ovoid in shape and have a thick shell that is radially striated. The further development of the embryo does not take place in the same host that shelters the tape-worm. If the embryos reach the stomach of the pig, the egg-shell becomes dissolved, the embryos are liberated, and bore their way into the wall of the stomach or intestine. They proceed by way of the blood or active migration into different organs. Having found a lodging-place, the embryo

undergoes changes and becomes in two or three months a cyst filled with serum, from whose wall there shoots forth, like a bud, toward the interior a scolex; from this a new tape-worm head develops, and also a sac enveloping it. The cyst with tape-worm head is called a "measle," or *Cysticercus cellulosæ*. The scolices when fully developed possess a circle of hooks, suckers, water-vascular system, and numerous calcareous bodies in their body parenchyma. If they enter the human stomach, the cyst dissolves, and develops, through formation of segments from their primary host, a new chain of proglottides, a new *Tenia solium*. The *Tenia solium* occupies the small intestine in man, and is acquired by eating uncooked pork.

The "measles" of this parasite occur almost solely in human beings and swine. There is generally only one parasite in the intestine, but there may be more, as many as 30 or 40 having been found in one individual. They cause irritation of the intestinal mucous membrane, colic, and reflex disturbances of the central nervous system.

In the tissues of swine the "measles" are sometimes single, often numerous, and single organs like the heart may be thickly sprinkled with them. In man the cysticerci occur in varied tissues, as the muscles, brain, eyes, skin, etc. In the brain they may appear as a collection of cysts like bunches of grapes, called *Cysticercus racemosus*. The cysts are mostly sterile, but some may contain a scolex.

The importance depends upon their location, but is generally slight, and even when in the brain does not always cause trouble.

Locally a slight inflammation is excited which causes a thickening of the connective tissue in the vicinity of the cyst. After the death of the scolex the cyst shrivels up, and within it there is a chalk-like mass. In this mass the hooks remain a long time. Infection with the "measles" follows the presence of the eggs, or proglottides, in the human stomach.

***Tenia Mediocanellata* (or *Saginata*).**—This worm surpasses the *Tenia solium* in length, breadth, and thickness, as well as in size of the proglottides. The *head* is about 2 mm. broad and without a circle of hooks, but has a flat crown and four large suckers, which are generally surrounded by a black fringe of pigment. It is nearly white in color. The eggs are similar to those of the *Tenia solium*. The "measles" are found in the cow, chiefly in the muscles and heart, more rarely in other organs, and are smaller than in swine. The development follows a similar course to that of the *Tenia solium*. This worm is more widespread than the *Tenia solium*, and human beings acquire it by the consumption of *raw beef*. Usually but a single worm exists, but as many as forty have been found in a single host. Man may become infected by either embryos or scolices, but strobiles never develop in cattle.

***Tenia Cucumerina* (or *Elliptica*—*Dipylidium caninum*).**—This worm is from 15 to 20 cm. long, and possesses a rhomboid head with a retractable rostellum bearing four circlets of hooks. The segments are elongated and elliptic in shape, each having a double genital apparatus with a sexual opening on each side. It occurs frequently in dogs and cats, but seldom in man.

Its cysticerci infect the louse and

flea of the dog; more rarely, the flea of human beings.

Tenia Nana (*Hymenolepsis nana*).—A small tape-worm from 8 to 15 mm. long, found in Egypt and Italy. The head has a retractable rostellum and four suckers and a circle of hooks. The segments number about 200 and are broader than long. It is found in dogs and cats and is not uncommon in children, in whom it possibly causes enuresis nocturna and epileptiform convulsions. Grassi thinks it can develop from eggs without an intermediate host, though possibly insects and snails may act as such. **Male fern** is the only known useful remedy for their removal.

Bothriocephalus Latus, or Pithead.—This is the most formidable tape-worm of man, and measures 5 to 10 meters in length. It is made up of from 3000 to 4000 short, broad segments. These are broadest in the middle region, and grow narrower toward the end. The length of the largest segment is 3 to 5 mm.; width, 10 to 12 mm.

The head has an elongated oval or club shape. It has on each lateral border a slit-like depression, which act as suckers, and is mounted on a filiform neck. There are no hooklets. The body is thin and flat like a ribbon, except the central parts of the segments, which project outward. There may be as many as 4000 of these. At this point the uterus, in the shape of a simple canal, is found. When the eggs collect here in great numbers, the lateral coils of the uterus arrange themselves in knots, producing a rosette-like appearance. The sexual orifices lie in the median line of the ventral surface. The ovary is a double organ, which lies in the

middle layer. The testicles consist of clear vesicles lying in the lateral part of the middle layer. The eggs are oval, surrounded by a thin, brown shell, are larger than those of the *Tenia solium* and *Tenia saginata*, and have a lid-like structure at one end.

The *Bothriocephalus latus* is found in Switzerland, northeastern Europe, Holland, and Japan. Bollinger says it is quite common in Munich. It lives in the small intestine of man. The first development of the eggs takes place in water. Months afterward an embryo develops, armed with hooklets, and covered with minute ciliæ. This develops in an intermediate host into a "measle," which, according to Braun's investigations in the Russian Baltic Sea provinces, seeks out as a mediate host the pike or tadpole, and either in the muscles or intestines of these fishes develops to a sexless tape-worm.

The so-called "measles" of the *Bothriocephalus latus*, according to Grassi and Parona, occurs in Italy in the pike and river perch. It is found in a Japanese fish, and in a great variety of fishes in the lake of Geneva. It is, however, most frequently found in the tadpole and perch. The "measle" may also be brought to development in the dog or cat.

The presence of the *Bothriocephalus latus* in the intestine of man may give rise to progressive anemia, resembling pernicious anemia. It is to be noted that, contrary to other verminous parasitic diseases, eosinophilia does not occur. How it causes a diminution of the red blood-corpuscles and the percentage of hemoglobin in the blood is unknown, but may be due to toxins elaborated by the worm.

Hymenolepsis diminuta (*Tenia flavopunctata*; *Tenia leptocephalata*).—This is a small cestode, 20 to 60 mm. long, with a club-shaped head and nearly 1000 segments. It is common in rats and has been found in man. The cysticerci (larvæ) develop in caterpillars, cocoons, and in beetles.

The *Tenia confusa*, *Tenia madagascariensis*, and *Tenia serrata* are cestodes occasionally found in man.

Symptoms.—Tape-worms are found in human beings of all ages, but they are by no means common in children. Holt's statistics are very conclusive on this point: of 10,000 cases studied, only 79 gave undoubted evidence of tape-worm. Cestodes may cause no disturbance whatever, and yet occasionally very grave phenomena, such as profound anemia, malnutrition, and nervous symptoms. There may be anorexia, voracious appetite, constipation or diarrhea, colicky pains in the abdomen, indigestion, nausea, vomiting and lassitude. When evidences of their presence are discovered, they are liable to produce much anxiety. In nervous folks there follows frequently profound mental depression and hypochondriasis. There is some evidence to show that teniæ produce convulsions, choreic symptoms, pruritus of the nose and anus, vertigo, migraine, and tinnitus aurium, especially in children. The diagnosis need never be difficult, the presence in the stools of segments of the worm and ova can be demonstrated by a careful search, and are readily differentiated.

Treatment.—Prophylaxis should consist in the use of **pure water** and **well-cooked food**. **Feces** of infected patients should be **burned** and the **meat-supply rigidly examined**. For

the treatment of the intestinal cestodes it is necessary to prepare the patient, who should take a very light **diet** for two days. A large enema of **cold water** or a thorough **saline purge** should be administered in order to prepare as free a passage as possible for the worm. No breakfast should be given on the day the anthelmintic is to be administered. There are a number of remedies advocated, of which the best is, perhaps, **pelletierine**, but this is not suitable for children and is also very expensive. The dose is 5 to 8 grains (0.3 to 0.5 Gm.) with 5 grains (0.3 Gm.) of **tannin** in sweetened water.

For children, most authorities recommend the **oleoresin of male fern**, four doses of 15 minims (0.9 c.c.) each in capsule given at intervals of an hour and followed by an active purge, such as **castor oil**. It must be borne in mind that flicic acid dissolves more readily in the presence of castor oil, and is hence absorbed in greater quantity, causing very considerable constitutional disturbance. Gross (La méd. mod., March 20, 1895) notes a case of blindness in a man, followed by optic atrophy, thus caused. Two cases, of more or less complete amaurosis, from the use of male fern, have been noted by Mazius (La Sem. méd., July 3, 1895).

For adults the dose of the **ethereal extract of male fern** is 2 drams (8 Gm.).

℞ *Fresh ethereal extract of male fern* ʒij (8 Gm.).
Powdered jalap . gr. viiss (0.5 Gm.).
Simple syrup, q. s. ad fʒj (30 c.c.).

Sig.: Shake well and take at one dose.
(Schilling.)

It is customary to combine **fili-mas** with an infusion of pomegranate-

root or pumpkin-seeds. Osler recommends an infusion of **pomegranate-root**, $\frac{1}{2}$ ounce (15 c.c.); **pumpkin-seed**, 1 ounce (30 Gm.); **powdered ergot**, 1 dram (4 Gm.), and boiling water, 10 ounces (300 c.c.). An emulsion of 1 dram (4 c.c.) of the ethereal extract of **male fern** containing 2 minims (0.12 c.c.) of **croton oil** is then made. After using a low diet on the previous day and an efficient laxative that night, the emulsion and infusion are mixed together and taken, fasting, the next day.

Pumpkin-seeds alone are very efficient. Three to 4 ounces (90 to 120 Gm.) should be carefully bruised, and macerated for half a day and the entire amount of the infusion taken and followed in an hour by a purge. Copper oxide in doses of $1\frac{1}{2}$ to 3 grains (0.1 to 0.2 Gm.) three times a day, for several days, is recommended by Sasse, the only restriction being the avoidance of acid drinks. A purge is given at the end of a week. An infusion made of $\frac{1}{2}$ ounce (15 Gm.) of the flowers of **kousso** (*Brayera anthelmintica*) to a pint of water (500 c.c.) and mucilage of acacia is a good remedy and is given in the dose of a wineglassful every half-hour. **Kousin** in 30- to 40- grain (2 to 2.6 Gm.) doses may be used, but is contraindicated in pregnancy. Powdered **kamala** in 1- to 3- dram (4 to 12 Gm.) doses in wine or water, **oil of turpentine** in doses of $\frac{1}{2}$ to 2 ounces (15 to 60 c.c.) in emulsion or milk, and **thymol** are also useful.

Unless the head is brought away, the segments of the parasite reproduce themselves, and in three or four months show in the feces. Where the head and neck are protected beneath the valvulæ conniventes, the remedies

may not reach the parasite. Unless the worm is killed, it is probable that no degree of peristalsis can dislodge the head. This is especially true of the *Tenia solium*. A good device is to place warm water in the vessel into which the dejecta are received, as it is thus more likely to be preserved entire.

VISCERAL CESTODES.—The larval forms of certain of the tape-worms invade the solid organs and produce important symptoms. The two varieties which more commonly occur in man are, first, the *Cysticercus cellulosæ*, the larva of the pork tape-worm, or *Tenia solium*; and, second, the echinococcus, the larva of the *Tenia echinococcus*. The *Cysticercus tenia saginata* has been known to occur in man, but is very rare.

Cysticercus Cellulosæ.—The ripe ova of the *Tenia solium* are occasionally received into the human stomach either by being accidentally swallowed or forced into the organ from below. The human then becomes the intermediate host of this cestode, which is usually the *Sus domesticus*. It thence invades various tissues and organs. Pigs are sometimes found swarming with these "measles," and in them there is rarely any constitutional disturbance except possibly at first. If in man only a few of these "measles" become established, the larvæ may die, become calcified, and produce no mischief. They are very rare in America. The symptoms produced where a considerable number occur or where the localities invaded are sensitive are sometimes very serious, and are divided by Osler into general, cerebrospinal, and ocular. The *general* symptoms resemble in many instances a peripheral neuritis.

When the *cerebrospinal* tissues are involved, very pronounced symptoms may result, according as the centers are invaded or the more silent regions are occupied. The *ocular* symptoms can be more or less readily elucidated by a direct examination of the eye, as the presence of the cysticercus in the vitreous humor has been frequently noted.

ECHINOCOCCIC DISEASE. — This disorder, both general and local in its manifestations, arises from the invasion by the larval forms of the *Tenia echinococcus* of the liver, intestinal canal, lungs and pleuræ, kidneys, bladder, genitalia, brain, spinal cord, bones, heart, and blood-vessels, and occasionally other organs.

In America this disease is extremely uncommon and even then occurs only in foreigners with rarest exceptions. It prevails in countries where man lives in intimate association with dogs, as in Australia, Iceland, and some parts of Europe.

The *Tenia echinococcus* lives in the intestinal canal of the dog. It is 4 mm. long, and has only four segments, of which the posterior one surpasses in length all the others put together, and alone is mature. The head is provided with four sucking disks and a rostellum with a double row of hooklets 30 or 40 in number with coarse root-processes. Only the cyst-worm is found in man, and sometimes in the hog, ox, horse, and sheep.

The development of the embryo takes place in the stomach or intestine, where the shell of the ovum is digested away; it then burrows through the intestinal wall, arriving at the peritoneal cavity or the muscle; or, falling into the portal circulation, it may be carried to the liver, which,

in at least one-half of the cases, is its destination. Again, it may enter the systemic vessels and be carried to various organs and regions of the body. Upon reaching its destination the six hooklets with which it is originally equipped disappear, and a cyst is formed, presenting two layers: an external, laminated, cuticular layer or capsule, and an inner, granular, parenchymatous layer or endocyst. These embryonal cysts grow and bud, develop from the parenchymatous layer, and themselves become cysts similar to the first one. Thus, the parent-cyst as it grows may contain a dozen or more daughter-cysts, inside which last again a similar process occurs, and a series of third or grand-daughter-cysts in time develop. From the lining membrane brood-capsules arise by budding; these mature into scolices, which are found to be heads of the *Tenia echinococcus*, presenting four sucking disks and a circle of hooklets. Should a scolex reach the intestines of a dog, it may develop into a similar tape-worm.

An interesting and important difference between the natural history of the *Tenia solium* and the *Tenia echinococcus* is that the ovum of the former develops into a single larva, whereas that of the latter forms a cyst which amplifies itself enormously, and from the lining membrane of which millions of larval echinococci are in turn produced.

In man, as a rule, the growth of the echinococcus is, as described, endogenous, the secondary and tertiary cysts being contained within the primary; in animals, however, the development may be exogenous. The primary cyst penetrates between the layers and matures externally. A third form is

the multilocular echinococcus, occurring in the liver only where the primary cyst-bud develops and is cut off entirely, becoming capsulated. These joining together produce a dense mass composed of connective tissue inclosing spaces in which are found remains of the echinococcic cyst oftentimes sterile: *i.e.*, without heads or larvæ. It resembles cancer, and the symptoms are those of tumor. The echinococcus lives a varying time, oftentimes many years. The usual change is death and inspissation of the contents and the transformation into a mass of partially calcified granular material. They may, however, rupture into a serous sac or external perforation, whereupon the cyst is discharged into a bronchus or the urinary passages or the bile-ducts or blood-vessels. From these effects death may follow very suddenly or recovery may ensue. Suppuration may become established, and large abscesses are sometimes formed, which contain hydatid membranes.

Symptoms.—About 50 per cent. of hydatid cysts are found in the liver. When these are of considerable size, the tumor or tumors are detectable by palpation and otherwise, the size of the organ being sometimes markedly increased. When these are small, they may not be distinguished or give rise to any disturbances. When they occur in the epigastric region on the anterior surface of the organ, they can be distinctly appreciated by touch, a feeling of density and occasionally a fluctuation being sometimes elicited. Occasionally they are found near the left suspensory ligament, disturbing the position of the heart upward, and an area of percussion dullness can be demonstrated in

the lower sternal and the left hypochondriac regions. If the tumor occur in the posterior surface of the right lobe, the liver is enlarged upward, encroaching upon the pleura, and the area of dullness in the axillary line is higher. A percussion fremitus can be detected if the cyst lies very subcutaneously. This consists of a tremulous or vibratory movement conveyed to the fingers of the left hand while percussing at the same time with the right.

Subjective symptoms of pressure or dragging and occasionally pain are experienced in the region of the liver; little more disturbance is caused than this. Where suppuration occurs, there are the usual symptoms of pyemia, along with jaundice and rapid emaciation. Perforation may take place externally or into the stomach, colon, pleura, or the bronchi; where this is into the pericardium or inferior vena cava, it is, of course, fatal.

Renal colic may be caused by cysts or portions of the membrane blocking the ureter. The lung is affected in about one-fifth of the cases, the symptoms being those of pneumonic compression along with displacement of the heart. The pleura is sometimes primarily affected, the signs being those of an ordinary effusion; but the line of dullness is generally quite irregular and there is rarely set up an acute pleurisy.

Echinococci of the lung may, when small, cause very little disturbance, but when large the symptoms of compression obtrude themselves; inflammatory changes may be set up, resulting in hemorrhage, gangrene, and cavity formation. Perforation of



Echinococcus Colony in the Liver. (Semischematic.)

the pleura with empyema is common, but this is rare.

Abscess of the liver caused by the echinococcus is obviously a serious disorder. In a large number of cases which come to autopsy the cyst is found to be harmless and the parasite dead.

The kidney is sometimes infested by the echinococci, and symptoms are set up resembling an hydronephrosis. The nervous system is occasionally affected, especially the brain—most frequently the cerebrum. The symptoms are vague, being those of tumor, as headache, convulsions, blindness.

Diagnosis.—To differentiate between hydatid cysts and *other tumor masses* it is best to make an exploratory puncture. In some instances hooklets may be found in the fluid, which, as a rule, is clear, of a neutral reaction, and varies from 1.005 to 1.009 in specific gravity.

The presence of a marked enlargement in the left lobe of the liver, irregular in shape and painless, or in the epigastric region, a smooth, fluctuating mass, giving the sensation of an elastic growth, suggests hydatid disease; this is especially the case if, besides, there is hydatid tremor. A *syphilitic tumor of the liver* is firm and rarely fluctuates. Between hydatid disease and *cancer of the liver* it is difficult to distinguish except through the clinical history. *Hydronephrosis* may readily be mistaken for hydatid disease, and can only be distinguished by exploratory puncture, or the discovery of small cysts in the urine.

Treatment.—Medicines administered internally can have little or no effect upon the course of the disorder. When the cyst is large or annoying

it must be treated surgically. **Aspiration of the contents** is harmless, and should be attempted before more radical measures. Recovery, in most instances, follows **incision and evacuation of the cysts.**

PARASITIC INFUSORIA.—*Trichomonas hominis* (*Cercomonas hominis*) is an intestinal parasite which may cause acute and chronic diarrhea associated with abdominal pain.

Lamblia intestinalis is an intestinal parasite which has also been found in sputum in cases of gangrene of the lung and bronchiectasis and in pleuritic exudates.

The *Trichomonas vaginalis* is a flagellate not uncommon in vaginal secretions. It is 15 to 25 micra long and has four flagella.

The *Balantidium coli*, one of the infusoria, is a common parasite of pigs and, according to Harlow Brooks, may cause an epidemic dysentery in apes. It has been found in the stools, on the mucosa and in the mucous and submucous coats of the intestine.

STOMACH PARASITES.—Parasites of the stomach are not common. Occasionally the *Ascaris lumbricoides* and the *Ascaris vermicularis* may enter the stomach, but it cannot be considered their natural habitat. The larvæ of certain insects seem to be able to cause gastritis. Occasionally fungi, as the favus, may grow in the stomach and rarely the tubercle bacillus and *Treponema pallidum* may be gastric parasites. Sarcinæ and yeasts may be found in cancer and dilatation of the stomach.

PSOROSPERMIASIS.—The term psorospermiasis includes several diseases produced by psorosperms (sporozoa; gregarinidæ; cytozoa), which belong to the lowest order of protozoa.

These parasites are common in the invertebrates and may occur in the higher mammals and man. The *Sarcocystis miescheri* is found in the muscles of the pig, the *Coccidium oviforme* in the liver of the rabbit, and the *Sarcocystis hominis* is sometimes found in man.

Psorosperms are found both as internal and cutaneous parasites. In internal psorospermiasis the liver is most frequently the seat of the disease, which resembles that produced by the *Coccidium oviforme* in the rabbit. Fever, chills, malaise, drowsiness, and unconsciousness have been noted in infected patients. The liver is tender and nodules may be palpated. Osler reports a case which died on the fourteenth day after admission to St. Thomas's Hospital. The post-mortem examination showed whitish neoplasms upon the peritoneum, omentum, pericardium, and a few in the liver, spleen, and kidneys. Silcott reported a case of a woman, aged 53, who had a chill, intermittent fever, diarrhea, nausea, dry tongue, and tenderness over the liver and spleen. Post-mortem examination showed an enlarged liver containing caseous foci, and the spleen weighed 16 ounces and contained similar nodules. The ileum presented six papular nodules containing coccidia. Cases have been reported where the parasites have been found in the kidney and ureters, with symptoms of frequent micturition and hematuria.

In external psorospermiasis, a dermatitis, characterized by hard, crusty papules, resembling a tuberculous infection, is found on the skin of the face, lumbar, abdominal, and inguinal regions, or on any part of the body. This was formerly called kera-

tosis follicularis, and it is still a question whether the disease is due to protozoa or to oïdia.

Treatment.—Prophylaxis consists in thoroughly cleansing green foods liable to contamination by excreta of the lower animals. The medical is symptomatic, though solutions of quinine (1:5000 to 1:1000) per rectum have been recommended.

J. MADISON TAYLOR,

AND

FRANK E. FREEMAN,

Philadelphia.

PARATHYROIDS. See ANIMAL EXTRACTS.

PAREGORIC. See OPIUM AND DERIVATIVES.

PAREIRA.—Pareira, N. F., is the dried root of *Chondrodendron tomentosum*, (family, Menispermaceæ). It is obtained from a tall, woody vine of tropical South America, especially of the upper valley of the Amazon; products of allied genera are commercially known as "false pareiras." Pareira contains buxine (pelosine or cis-sampeline), a bitter, tonic alkaloid, starch, tannin, gum, and phlobaphene.

PREPARATIONS AND DOSES.

Pareira, N. F. (the dried root). Dose, 30 to 60 grains (2 to 4 Gm.).

Fluidextractum pareiræ, N. F. (fluid-extract of pareira). Dose, ½ to 1 fluidram (2 to 4 c.c.).

Infusum pareiræ (infusion of pareira, unofficial), is made by infusing 1 ounce (30 Gm.) of pareira in 1 pint (500 c.c.) of boiling water. Dose, ½ to 1 fluidounce (15 to 30 c.c.).

PHYSIOLOGICAL ACTION.—Pareira is valued principally as a diuretic and laxative. It has a stimulating influence upon the mucous membranes, especially that of the genitourinary tract.

THERAPEUTIC USES.—The liquid preparations of pareira combined with the alkalies are principally used in the treatment of irritable bladder, cystitis, pyelitis, chronic urethritis, and in leucorrhea. In

South America it is administered for **snake-bite**, and is also applied externally to the wound.

PARESIS, GENERAL. See PSYCHOSES, PSYCHASTHENIA, AND PSYCHONEUROSES.

PAROTID GLAND. See SALIVARY GLANDS, DISEASES OF.

PAROTITIS. See SALIVARY GLANDS, DISEASES OF.

PARTURITION, ABNORMAL. See PREGNANCY AND PARTURITION, DISORDERS OF.

PEDICULOSIS. See HAIR, DISEASES OF.

PELLAGRA. See TOXIC FOODS.

PELLETIERINE.—Pelletierine, or punicine, is the alkaloid obtained from the root-bark of the pomegranate (*Punica granatum*, L.), or Granatum, U. S. P. As found in the shops it consists of a mixture of pelletierine and isopelletierine. It occurs as a colorless, oily liquid, of aromatic taste and odor, and is soluble in 20 parts of water, and more soluble in chloroform, alcohol, and ether. It readily forms salts with the acids, of which the tannate is most commonly used. The tannate occurs as a yellowish or grayish-brown, amorphous, hygroscopic powder, having a slight astringent taste and weak acid reaction. It is soluble in 12.6 parts of alcohol, in 235 parts of water, and in warm dilute acids. Tanret's pelletierine is a syrupy solution, sold in bottles, each containing one dose.

PREPARATIONS AND DOSES.—The official preparations are:—

Granatum, U. S. P. (pomegranate bark). Seldom used in the crude form.

Fluidextractum granati, U. S. P. (fluid-extract of pomegranate bark). Dose, 20 to 30 minims (1.3 to 2 c.c.).

Pelletierinæ tannas, U. S. P. (tannate of pelletierine). Dose, 3 to 8 grains (0.20 to 0.50 Gm.) in syrup or capsule.

PHYSIOLOGICAL ACTION AND THERAPEUTICS.—Pomegranate is a powerful astringent, and a decoction,

flavored with aromatics, is useful in pharyngitis and as an injection in urethritis. Coronedi has found that pelletierine, in poisonous doses, paralyzes the peripheral ends of the motor nerves very much in the same way as curare does, without influencing contractility or destroying sensibility, and acts chiefly on the lower limbs, in which cramps may precede the loss of power. Even in full medicinal doses it may cause general muscular relaxation, frequently giddiness, confusion and uncertain vision and occasionally nausea and vomiting. If the patient remains quiet after taking the drug, these unpleasant effects are often prevented. Pelletierine may also cause nausea and vomiting.

A decoction of pomegranate was formerly used in **serous diarrhea** and **profuse sweats** and in **dysentery**, but on account of its disagreeable taste and effect upon the stomach it is no longer used.

Dujardin-Beaumetz has successfully used pomegranate in Ménière's disease. According to Galezowski, pelletierine is of service in paralysis of the third and sixth nerves.

The special use of this drug is for the destruction of **tape-worms**. In tropical countries the powdered bark is used in doses of $\frac{1}{2}$ to $1\frac{1}{2}$ drams. The decoction (made by soaking 2 ounces of the bark in 2 pints of water for twenty-four hours, and then boiling down to a pint) is a nauseous dose, but generally efficacious; a wineglassful of this decoction is taken every hour until the whole pint is taken. Generally purging and vomiting follow, but should purging not occur, castor oil or other good purge should be used to expel the worm. A previous fast of twelve hours is necessary, whatever form of this drug is used.

Pelletierine tannate is given in doses of 3 to 8 grains in 1 ounce of water, followed in two hours by a brisk purge. As serious paralytic symptoms have ensued after the ingestion of 5 grains by a susceptible woman, not more than this amount should be given.

Pelletierine sulphate is much more dangerous than the tannate, and, if used, tannin should always be administered with it.

W.

PELVIS, INFLAMMATORY DISEASES OF. See UTERUS, DISEASES OF.

PEMPHIGUS.—Almost all cutaneous affections in which bullæ occurred, except those in which the bullæ resulted from traumatism, were included under the term pemphigus. Many of the bullous eruptions have been found to be distinct entities, differing in their symptoms, course, and etiology, so that the term pemphigus is now applied to a comparatively restricted group. It may be interesting to mention briefly the bullous eruptions formerly included in the pemphigus group:—

Pemphigus congenitalis is a rare bullous affection generally becoming apparent late in the first month of life, although it may be present at birth. The bullæ usually develop as a result of traumatism to the skin, as scratching, rubbing, rough handling, or pressure. It is sometimes known as traumatic pemphigus, but more commonly as “epidermolysis bullosa hereditaria.”

Pemphigus contagiosus is a purely local bullous affection, and is spread by contact. It is a bullous form of impetigo due to inoculation, through an abraded skin, of a streptococcus.

Pemphigus gravidarum is a bullous eruption occurring occasionally in pregnant women, but more often during the puerperium. It is included by Duhring as a form of “dermatitis herpetiformis.”

Pemphigus hystericus is a rare bullous eruption associated with a functionally disturbed nervous system and hysterical symptoms. In many cases the bullæ are artificially produced by cantharides or other blistering methods.

Pemphigus leprosus is a cutaneous lesion of leprosy, in which the bullæ are secondary to the invasion of the nerves supplying the affected areas by lepra bacilli.

Pemphigus neonatorum is a bullous eruption of newborn infants due to infection. (See NEWBORN, DISEASES OF.)

Pemphigus syphiliticus is a bullous syphilide, found usually on the palms and soles of syphilitic infants, and is almost always associated with other stigmata of hereditary syphilis.

True pemphigus may be divided into two general varieties, acute and chronic, and the latter may be subdivided into *Pemphigus foliaceus* (Cazenave) and *Pemphigus vegetans* (Neumann). It will be seen that while the characteristic feature of real pemphigus is the bleb, it must, as Schalek remarks, be elementary, begin as such, and not be due to secondary changes of other skin lesions; it must not be a local condition, but the manifestation of a grave internal disorder having a chronic course with exacerbations and remissions, and causing profound systemic depression and frequently death.

ACUTE PEMPHIGUS.—This is a type of acute bullous eruption accompanied by severe constitutional symptoms of a septicemic nature and is usually fatal. This form has usually been observed in adults, principally butchers or those who handled animal products such as hides. The eruption in these cases is more or less widely disseminated, invading the mucous membrane and the skin. There is usually a definite history of traumatism—a scratch on a butcher, a poisoned thumb in a tanner, a sore following a dog-bite, etc. (Macleod). After a period of incubation which may be several months, the bullous eruption appears, either suddenly or after certain prodromata—chilliness, malaise, etc., and either upon apparently healthy skin or upon erythematous patches. Associated with the eruption are constitutional symptoms of a septicemic type, varying according to the extent of the eruption, which ordinarily terminate fatally.

The etiological factor is believed to be a specific microbe of animal origin, which enters the system through a break in the skin-surface. As the microbes multiply they cause the septicemic symptoms, and the eruptions of bullæ, either locally from autoinoculation or by being transported in the blood-stream. Bulloch and also Demme have isolated a diplococcus which is believed to be the pathogenic agent.

CHRONIC PEMPHIGUS.—This is considered the classical type of the disease. In this form the bullæ appear as vesicles, and gradually increase in size until they become as large as a hen's egg. As a rule they form on apparently healthy skin,

and come out regularly, or in crops. A slight febrile disturbance with malaise may precede the eruption, or prodromata may be absent. Subjective symptoms (burning and itching) are usually lacking. The blebs last from three to ten days. A succession of crops may follow for weeks or months and then gradually subside. The bullæ contain at first clear serum, which soon becomes cloudy and purulent, and surrounded by an inflammatory halo. The blebs may become the seat of hemorrhage or gangrene. Not infrequently the mucous membranes of the mouth, stomach, and nose may be invaded.

The etiological factor of this affection is supposed to be a toxin, the nature of which is unknown. Various micro-organisms have been found in the bullæ.

Pemphigus Foliaceus.—In this variety of chronic pemphigus the bullæ abort before maturity and either become patches of exfoliating epidermis or persist as flaccid blebs which rupture and leave shiny, moist patches, lacking more or less epidermis, or the blebs may be covered with crusts. The mucous membranes may be invaded, and the nails and hair may be lost. The general health soon becomes impaired and the kidneys and other internal organs involved, the patient becoming weaker, and collapse preceding death. If recovery takes place, as it may in rare cases, remissions are the rule. The etiology of the affection is unknown, but an excess of eosinophile leucocytes are present in the blebs and in the blood, from which Leredde concluded that it was a toxic disease, chiefly involving the bone-marrow and other blood-forming organs, and that the poison carried by the blood-stream caused the eruption on the skin. A microbic origin has also been suggested.

Pemphigus Vegetans.—In this variety of chronic pemphigus the bullæ in certain situations, as in the axillæ, about the genitalia and sides of the mouth, are succeeded, after rupture, by vegetating growths arising from the denuded base, and coalescing to form fungous masses. The eruption has a tendency to become serpiginous, and to ulcerate. Where the skin is moist, the fungous masses appear. Severe constitutional symptoms accompany the eruption, with a fatal issue in

most cases. In milder cases death may be delayed for years, and be preceded by remissions. The disease is considered by most authorities to be caused by bacteria, a systemic toxic infection resulting, the fungating masses being probably due to secondary staphylococcic inoculation of the lesions. This latter seems probable, since the use of antiseptics cause the disappearance of the vegetations. Among the microbes found are a pseudodiphtheritic bacillus pathogenic to guinea-pigs (Waelsch), streptococci (MacCormac), and *B. pyocyaneus* (Winfield and Pernet). Jamieson and Welsh have, however, repeatedly found the blebs to be sterile and streptococci absent; degenerative changes in the spinal cord, cerebral cortex, and sympathetic ganglia in a case under their care suggested bacterial origin.

TREATMENT.—**Arsenic**, beginning with small doses and increased until the physiological limit is reached, is perhaps the most valuable internal remedy. **Quinine** in full doses, **iron**, **strychnine**, and **codliver oil** are also of value. **Hygienic measures**, **nutritious food**, and **rest** for the mind and body are all important.

Local treatment should aim to heal the abraded surfaces and to relieve the subjective symptoms. The **blebs** should be **evacuated**, and **soothing ointments**, **lotions** or **dusting powders** applied. **Calamine lotion** and **bran and starch baths** are valuable. In grave cases the **continuous warm bath** may be used, day and night, for months. W.

PEMPHIGUS CONTAGIOSUS.

—This disease, more commonly known as *Pyosis mansonii*, is a form of bullous pyosis affecting the axillary, inguinal, and scrotocrural regions. It is quite prevalent in Burma (Castor) and in the low-lying districts of the tropics. It has no connection with true pemphigus, but is closely related to impetigo, of which it may be considered a variety. Although the eruption generally attacks the regions named, it often extends to the abdomen, back, and limbs, but rarely the face. It is extremely contagious, and is more marked in those who perspire freely and suffer from prickly heat. The eruption occurs as flattened, rounded vesicles which rapidly en-

large to the size of a small pea. More rarely, very large, flabby, pemphigoid bullæ may be seen. The contents of the bullæ, at first transparent, soon become turbid. The vesicles are frequently surrounded by a pinkish or reddish inflammatory halo. The vesicles collapse on puncture. The general health is rarely affected. The eruption may be very persistent and may be followed by a crop of boils. A journey to the hills or to a cool climate causes spontaneous disappearance of the eruption.

The etiology is not certain. Manson found a diplococcus. Leishmania-like bodies have been observed by others. Clayton, Castellani, and Chalmers have found cocci generally arranged in pairs, and having often a gonococcus-like shape, which are Gram-positive and in cultures present all the characteristics of *Staphylococcus pyogenes aureus* and *albus*.

The disease resembles chicken-pox and impetigo contagiosa. From the former it is differentiated by the absence of fever and the location of the vesicles; from the latter by the absence of crusts.

TREATMENT.—Antiseptics are most useful. The eruption should be disinfected twice daily with antiseptic solutions, such as mercury bichloride (1:2000), carbolic acid (2:100), potassium permanganate 1:4000, hydrogen dioxide (10:100), or lysol (2 to 5:100). The vesicles are evacuated, the region again washed with the disinfectant, and an antiseptic powder freely dusted on the surface. After the eruption has healed, Condyl's fluid or other disinfectant should be used in the bath to prevent relapse. W.

PENIS AND TESTICLES, DISEASES AND INJURIES OF.—DISEASES OF THE PENIS.—ANOMALIES.—Anomalies of the penis are so extremely rare that they possess but little clinical significance. Such patients are often mentally deficient and so afflicted with other extensive malformations and deformities that they rarely survive for any great length of time.

Absence of the Penis.—This is the rarest of anomalies of the penis, and,

with the exception of a case reported by Demarquay, practically unknown except in very young children. In Vinogradoff's case, a boy aged 7, although the penis was absent, the scrotum and testicles were normal. The urethra may open into the rectum, by the margin of the external sphincter, or in the perineum. It is highly probable that some of the cases of absence of the organ are really instances of rudimentary or concealed penis.

Concealed Penis.—A few cases have been reported in which the penis was small, undeveloped, and concealed beneath the skin near its normal situation. The penis may be concealed in cases of elephantiasis of the scrotum or large hernia. Urine was passed through a fistulous opening in several cases; in others no opening could be found, and retention of urine followed.

TREATMENT.—In every case of apparent absence the organ should be carefully searched for, freed by incisions, and by a plastic operation covered by skin taken from the neighboring parts.

Rudimentary Development.—Rudimentary penis, especially when complicated with cryptorchism or other abnormalities, is not uncommon. Men of middle age with genitalia no more developed than children of 5 or 6 years are frequently seen. Many of these cases, however, are capable of marital relations, and have successfully impregnated women, although impotence is the rule.

TREATMENT.—In many instances but little can be done for the relief of this condition. When seen in early life, preputial adhesion or a tight phimosis should be relieved. In the young adult a suction apparatus has

been recommended and employed with considerable success. A bell-jar fitting tight around the root of the penis is exhausted by a rubber bulb, thus causing congestion and distention of the erectile tissue. Such treatment should be carried out over a long period.

Hypertrophy of the Penis.—The size of the penis bears no relation to the size of the individual. In imbeciles and dwarfs it may be enormous, while in the well developed it may be quite small. Hypertrophy of the penis may render coitus impossible, and may be a source of danger by predisposing the patient to abrasions and fissures through which he may become inoculated with venereal poison.

Double Penis.—This anomaly has been noted in several authentic instances. The two organs are usually placed side by side, and other evidences of monstrosity generally exist (supernumerary limb). In several of the cases the function of both organs was perfect, as regards urination, capability of erection, and seminal emission.

Torsion of the Penis.—Twisting of the penis on its long axis so that the frenum is uppermost is most uncommon. This condition is often accompanied by either epispadias or hypospadias. Urination and ejaculation of semen are, as a rule, not interfered with; hence no treatment is required.

Adherent Penis.—Through nearly its entire length the penis may be adherent to the scrotum,—of course, interfering with its function.

TREATMENT.—Such a deformity should be operated upon as soon as discovered in order to prevent stunting or incurvation of the organ. The

membranous septum should be divided along its entire length, and the raw surface remaining closed by sutures or by a plastic operation.

ANOMALIES OF THE PREPUCE.—The prepuce may be absent, redundant, or incompletely developed. Absence of the foreskin calls for no treatment, nor does incomplete development unless complicated by phimosis or an irritated or inflamed glans penis.

Adherent prepuce is often responsible for many reflex phenomena of a convulsive or paralytic type and stunted growth of the penis. Its treatment can be readily carried out, in most instances, by relieving the phimosis either by performing **circumcision** or by **stretching the preputial orifice**. The raw surfaces resulting from the latter procedure should be smeared with an ointment composed of a dram (4 Gm.) of **boric acid** to the ounce (30 Gm.) of **carbolized petrolatum**. The glans penis should be washed daily with **mild antiseptic solutions** and the ointment reapplied.

As cellulitis followed by death has resulted from the above stripping process, at least ordinary **antiseptic precautions** should be observed.

Occlusion or obliteration of the preputial orifice may not be detected immediately after birth, but the appearance of a tumor at the end of the penis due to the accumulation of urine will soon call attention to the trouble. The treatment of this condition is **circumcision**.

Short Frenum.—This congenital deformity occasionally interferes with complete erection, turning the orifice of the meatus down, and not only preventing ejaculation in the proper

direction, but rendering coitus painful or impossible.

TREATMENT.—The **base of the frenum** should be **divided** by a narrow bistoury, and the **prepuce kept retracted** until healing is complete.

PHIMOSIS.—A preternatural elongation of the prepuce with a contracted orifice rendering it impossible to uncover the glans penis is termed phimosis. The preputial orifice may be so small that a probe cannot be made to pass ("pin-point" orifice).

Varieties.—1. Congenital (always permanent). 2. Acquired: inflammatory (usually temporary); cicatricial (always permanent).

CONGENITAL.—The prepuce begins as a fold of tissue about the third month of fetal life; as it grows forward the inner surface of the foreskin becomes adherent to the glans penis. During the first year of life the prepuce generally becomes loosened; should this not occur a true phimosis results.

ACQUIRED.—The acquired may be either inflammatory or cicatricial. The inflammatory—balanoposthitis—usually occurs as a result of various forms of ulceration about the glans and prepuce. Cicatricial contraction results from the healing of ulcers, injuries, and bad circumcisions—the mucous membrane being left too long, thus permitting the scar to slip in front of the corona glandis.

Symptoms.—Moderate phimosis may exist without giving rise to symptoms. However, as a result of the decomposition of the retained smegma and urine and obstruction to the flow of urine, symptoms may develop which are exceedingly distressing and may permanently impair the general health. In children there are

symptoms which often simulate vesical calculus: balanitis, heat, itching, pain at the head of the penis, frequent erections, pain on urination, frequency of micturition, dysuria, or incontinence. Under the remote effects may be considered malnutrition, choreic movements, paralysis, convulsions, prolapse of the rectum, hernia, atony of the bladder, the latter conditions being most frequently seen when there is marked contraction of the preputial orifice requiring severe straining efforts to be made during urination. In older children the condition is apt to give rise to priapism, and is undoubtedly the cause of masturbation and often an arrest of development of the penis.

After puberty and later, functional sexual troubles begin: erections occasion intense pain, the repeated attacks of balanoposthitis reflexly predispose to nocturnal emissions, and coitus is painful or impossible.

When phimosis is unrelieved, the irritation of chronic balanoposthitis is the frequent cause of fissures, vegetations and adhesions; in later life, and, in consequence of it, cancer is liable to occur.

It is not uncommon in long-standing cases of phimosis to find one or more calculi beneath the prepuce due to decomposition of the urinary salts. These calculi may be very small, but, may, however, weigh several ounces.

Treatment.—*Permanent phimosis*, whether congenital or acquired, should always be treated by operation (**circumcision**). In the majority of instances congenital phimosis is spontaneously relieved. If the epithelial separation is not complete at birth, it may be quickly accomplished by the flat end of a probe, the raw surface

left being covered with **carbolized oxide of zinc ointment** to prevent adhesions.

For *temporary phimosis* following inflammations and ulcerations subpreputial **injections of Castile soap and hot water** with a flat-nozzled syringe should be made twice daily, followed by the use of a **lead-water and laudanum solution** to which $\frac{1}{2}$ dram (2 Gm.) of **carbolic acid** has been added to every 6 ounces (180 Gm.). During the day the entire organ should be kept wet with **lead-water and laudanum**.

CIRCUMCISION.—Operation for the removal of the prepuce is indicated in chronic balanoposthitis with or without adhesions; certain cases of paraphimosis; to prevent masturbation; when the sexual orgasm is too early induced; to prevent gangrene of the glans penis consecutive to concealed ulceration; tuberculosis, and epithelioma.

The usual antiseptic precautions are to be observed. With a pair of Ricord's phimosis forceps the prepuce is grasped just at the corona glandis, parallel to its obliquity, and the prepuce is drawn in front of the glans as the forceps are locked. With a sharp-pointed straight bistoury the prepuce is divided with a sawing motion through the fenestra of the forceps. The skin now retracts behind the corona, exposing the inner or mucous layer of the prepuce still covering the glans. With a fine pair of scissors this is now divided in the median line to the corona. The two flaps remaining are then cut off close to the edge of the corona, leaving just sufficient tissue to hold a stitch. This will prevent the scar from slipping in front of the corona, thus causing a

return of the phimosis. The frenal artery is now twisted or ligated with fine catgut, and the wound closed with fine-catgut sutures. The first suture should be introduced at the frenum, the second at the dorsum, and two or three at intervening points on both sides; care should be taken that the raw surfaces be accurately approximated. A **gauze bandage** wet with a 25 per cent. **boroglyceride solution** should be applied as a dressing. The bandage should be removed daily or every other day and the parts irrigated with 1:5000 **nitrate of silver solution** and the **boroglyceride** dressing be applied.

Sutures are almost always unnecessary in circumcision; they add to the length and pain of the operation, make the subject more prone to infection, and often leave stitch scars. The writer avoids them entirely by the following method: After the prepuce and the mucous membrane have been cut away in the usual manner, the skin and the mucous membrane can be made to adhere together very satisfactorily by applying several hemostats around the cut surface, placing them on the skin from before backward in such a manner as to grasp the mucous membrane and the skin with edges approximating between the jaws of the hemostat for a third of an inch, and compressing the jaws tightly. The fenestrations of the blades press the tissues together in corrugated ridges, and they will remain adherent, when, after a few minutes, the hemostats are removed. No sloughing occurs at the point of compression. The usual circular dressing is applied, leaving the meatus free. This dressing is changed every 24 to 36 hours. Healing is usually by first intention. In a very small percentage of cases a bleeding vessel may have to be ligated, but this occurrence is very rare and generally compression con-

trols the hemorrhage. S. Meredith Strong (Amer. Jour. Surg., March, 1914).

When the penis is large the operation may be done without the aid of forceps. A grooved director is introduced between the glans and the prepuce exactly in the median line, and on it both layers of the prepuce are divided at one time by scissors to the corona. An assistant with dissecting forceps makes slight traction upon the triangular flaps remaining, and with curved scissors the skin and mucous membrane are cut off close to the line of the corona as above described.

Circumcision, as is well known, is a prophylactic ritual procedure among the Jews. It is not infrequently a source of infection, however, while its prophylactic value is undoubted.

PARAPHIMOSIS.—Inability to draw forward a retracted prepuce from behind the corona glandis may be caused by gonorrheal balanoposthitis, chancres, chancroids, violent coitus, retraction of a tight prepuce, and any lesion of the glans or prepuce attended by swelling.

Accidents and infections are not uncommon in the performance of ritual circumcision. One of these accidents is the amputation of a small slice of tissue at the tip of the glans penis, and results from failure to employ the circumcision shield. A more serious injury is complete severing of the corpus spongiosum and urethra and partial severing of the corpora cavernosa. Another condition not infrequently met with is the persistence of preputial adhesions. F. Bierhof (N. Y. Med. Jour., May 18, 1912).

Comparative occurrence of venereal and non-venereal affections of the genitals among the non-circumcised (Christian) and circumcised (Jews

and Mohammedans) classes of Moscow, with the following results: In 7065 uncircumcised persons there occurred: non-venereal affections of the genitals, 1108 cases; gonorrhea and its complications, 1108 cases; hard and soft chancres, 1773 cases; syphilis with site of the initial lesion undetermined, 895 cases. In 412 circumcised cases there were: non-venereal affections of the genitals, 21 cases; gonorrhea and its complications, 299 cases; hard and soft chancres, 70 cases; syphilis with site of the initial lesion undetermined, 22 cases. This gives the following percentages for the 2 classes of patients: Non-venereal diseases of the genitals, uncircumcised, 15.68 per cent.; circumcised, 5.09 per cent. Venereal diseases of the genitals, uncircumcised, 95 per cent.; circumcised, 53.44 per cent. Pawloff (Dermat. Woch., Feb. 17, 1912).

Symptoms.—As a result of the mechanical constriction by the preputial orifice, the glans penis rapidly swells, and becomes red and tense. Over and behind the coronary sulcus is a brawny swelling, which represents the mucous layer of the prepuce. Behind this another deep groove is seen, which corresponds to the preputial orifice, the seat of constriction. If left untreated, gangrene may result; or it may remain chronic, the retracted tissue becoming inelastic and indurated.

Treatment.—When the paraphimosis is of sudden development and not dependent upon edema consecutive to ulcerative lesions, **reduction** should be attempted immediately. The organ should be rendered bloodless either by gentle pressure or by the application of a small finger bandage. The parts are then greased well with sweet oil, the index and middle fingers of each hand are crossed behind

the glans penis, and with the thumbs attempt should be made to force the glans penis through the swollen tissue. When reduction is possible, the foreskin will slip forward with a characteristic snap. Failing in this, the **preputial orifice is to be divided** in the second groove on the dorsum, with a curved, sharp-pointed bistoury, cutting from within outward. **Hot compresses** should be applied for several hours to restore the circulation and favor the absorption of the edema.

When paraphimosis is consecutive to ulceration and in no danger of causing gangrene, **hot compresses** or **lead-water** should be applied and at the same time the original lesion should be treated. These cases usually reduce spontaneously. If not, they should be treated as above described. Should the brawny edema of the reduced tissues persist for several weeks or months, **circumcision** is to be recommended.

INJURIES OF THE PENIS.—

Contusion.—Severe contusions of the penis occasion so intense an ecchymosis and edema as to simulate rapid gangrene. Small circumscribed tumors form, most prominent during erection, and result from the rupture of vessels in the cavernous bodies, forming hematmata. When the urethra is involved, blood will escape from the meatus, and inflammatory phenomena quickly develop.

TREATMENT.—Contusion may be treated by **rest, elevation**, and the application of **hot antiseptic compresses**. If the symptoms are progressive an **incision** should be made under strict antiseptic precautions and the **bleeding vessels ligated**. *Emphysema* is a serious symptom and necessitates free **incisions**, as does the first sign of *sup-*

uration; thorough **drainage** in this instance is essential. *Extensive swelling and discoloration* should not occasion alarm unless there has been rupture of the urethra or the cavernous or spongy bodies.

Incised Wounds.—Incised wounds, when slight, heal quickly when closed early. If, however, they are deep and the erectile tissue is involved, free hemorrhage results, and the possible loss of the power of erection in the part anterior to the wound. When the penis is completely divided hemorrhage may be so serious as to cause death unless quickly controlled.

TREATMENT.—All *hemorrhage* is to be controlled by **ligature**, the *venous oozing* is checked by the simple **apposition of the cut surfaces**. If it cannot be so controlled, a **hard-rubber catheter** may be introduced into the **urethra** and a **tight roller bandage** applied.

Such **remedies** as have a tendency to **prevent erections** should be administered internally. No matter how extensive the wound, an effort should always be made to **suture** together a divided penis. Cicatrices left after healing may distort the penis and render erections imperfect and painful.

When the urethra is divided it should be **sutured**, and a **catheter introduced** through the urethra into the **bladder** to prevent the formation of a urinary fistula; it should be removed at the end of the seventh day.

Punctured Wounds.—Like punctured wounds elsewhere in the body, infection is likely, and a severe inflammation usually results.

TREATMENT.—Whenever possible, all punctured wounds should be **converted into incised wounds** in order

to prevent infection and permit of **drainage** from the bottom.

Contused and Lacerated Wounds.

—These wounds are dangerous only when the tissues are devitalized to a great extent or the urethra involved. When extensive they are liable to be followed by loss of erectile power or distortion of the penis.

TREATMENT.—These wounds require treatment that will control the resulting inflammation. *When the urethra is involved*, a **catheter** should be passed through into the bladder and maintained in place for a week or ten days. Occasionally it may be impossible to pass an instrument from before backward. Under such circumstances it will be necessary to **open the urethra behind the injury** and pass the **catheter from behind forward**.

Gunshot Wounds.—Gunshot wounds simulate contused and lacerated wounds and are subject to the same complications. The **bullet** should always be removed.

Fracture of the Penis.—This injury may happen during coitus, “missing the mark,” the organ striking the outer wall of the vulva or the pelvic bone, and from traumatism calculated to “break” a painful chordee. The injury consists in a laceration of the corpora cavernosa, and is followed by an extensive hemorrhage into the subcutaneous tissues and great swelling. The erection immediately disappears, and the part anterior to the injury is unnaturally movable. When the urethra is involved there is an escape of blood from the meatus, and infection is extremely likely to occur. After such an injury the power of erection in the part anterior to the injury is usually lost; this may inter-

fere with coitus and cause permanent impotence.

TREATMENT.—Fracture of the penis may be treated either conservatively or radically. The injured organ may be kept wet with **lead-water** and **laudanum solution** and held firmly pressed against the abdominal wall by means of a **bandage**. The penis may be **incised**, the clots turned out, the **bleeding vessels** ligated, and the **rent in the capsule** closed with sutures. A permanent catheter should be introduced and the entire penis covered with an **anti-septic dressing** retained by a firm **roller bandage**. The catheter should be removed at the end of forty-eight hours and a new dressing applied. *Erections must be prevented* by the free use of **bromide of sodium** or **potassium** and by keeping the bowels regular.

Strangulation of the Penis.—This condition has been frequently noted in children because of the habit of tying strings or bands around the penis to prevent incontinence. Oftentimes a band or ring is slipped on the penis for the purpose of maintaining or increasing erections. Imperfect erections, traumatic strictures, and urethral fistulæ may follow; or, in rare instances, gangrene.

TREATMENT.—The **removal of the constricting body** is usually followed by a return to normal conditions. Ulceration may cause a circular scar which will interfere with erections in the distal part.

Dislocation of the Penis.—This injury results from a severe blow to the penis when in a flaccid state, tearing the subcutaneous cellular tissue at its root, forcing the organ to become incarcerated in the subcu-

taneous tissue of the abdomen, scrotum, perineum, or thigh. The mucous layer of the prepuce, which should prevent this accident, usually gives way along the line of the coronary sulcus. The urethra is occasionally ruptured in the perineum.

There are intense pain, extensive subcutaneous hemorrhage, and also bleeding from the meatus. Occasionally there are urinary extravasation and an abnormal position of the root of the penis.

TREATMENT.—The penis should be returned to its normal position by **traction** when possible, or by means of a **hook introduced into the meatus**. Failing in this it is proper to make **incisions** to permit of sufficient **manipulation** that the organ can be reduced. **Extravasations of urine** should be **opened and drained**, and an **external urethrotomy** or **perineal section** performed. Unless reduced early, adhesions may form which are at times difficult to remove.

INFLAMMATORY AFFECTIONS OF THE PENIS.—**Penitis.**—An inflammation of the penis which may be acute and due to gonorrheal folliculitis, erysipelas, rupture of the urethra with urinary extravasation, and wounds; or chronic, due either to the rheumatic or gouty diathesis or to syphilis. It is also ascribed to old areas of blood-extravasation which have undergone organization.

When superficial, all the signs of inflammation are present associated with a rapid, inflammatory edema. In the circumscribed variety the inflammatory symptoms are local and followed by the formation of a tumor, which finally softens, indicating pus formation. The diffuse form is rapidly followed by gangrene.

The chronic variety is characterized by slow-growing, painless areas of induration scattered through the cavernous bodies. The erect penis is bent at the seat of induration, and erections are usually incomplete in that part anterior to the node.

TREATMENT.—In the acute diffuse variety early **free and multiple incisions** are necessary to prevent gangrene; **drainage** should be provided for, and **antisepsis** maintained. *Where gangrene has already developed*, the treatment should be that appropriate for gangrene in other parts of the body. *When spreading slowly*, **hot antiseptic fomentations** should be applied until the slough separates, and the remaining simple **ulcer treated** on general principles. *In the rapid-spreading form of gangrene* the sloughs should be cut away, and the raw surface left touched with the **thermocautery**. **Circumscribed abscesses** of the cavernous bodies should be **opened early** and thoroughly drained. The function of the penis may be somewhat interfered with after healing.

In the *chronic form* of the trouble little can be done. **Iodide of potassium, arsenic**, subcutaneous use of **fibrolysin** and other remedies indicated in rheumatism and gout should be administered internally, while locally **mercurial** or **ichthyol ointment** should be applied. Occasionally **pressure with a fine-rubber bandage** will bring about a cure. Occasionally it is possible to remove these localized indurations by **operation**, and thus restore the normal erection. **Strict antisepsis** must be maintained.

Gummata of Penis.—This condition is rare, and is usually situated between the cavernous bodies.

TREATMENT.—Same as for gum-mata elsewhere.

Lymphangitis.—Lymphangitis is always secondary to peripheral inflammation and may be simple or venereal in origin. The vessels feel like fine wires beneath the skin and usually lead to the nearest lymph-glands, which will be found enlarged. Occasionally small nodules form which may soften, break down, and ulcerate, leaving small fistulæ, which may persist for a long time. The condition must be distinguished from phlebitis by the smallness of the vessels; the fact that they are not in the median line; the cord of induration extends outward, at the root of the penis, toward a group of enlarged glands, instead of disappearing beneath the pubic arch; and the much lessened edema.

TREATMENT.—**Rest, elevation,** and the application of **evaporating lotions**. When they are dilated without inflammation, **pressure** or the use of **mercurial ointment** may cause them to disappear; otherwise, **excision** is required to bring about a cure.

Phlebitis.—This is a rather uncommon condition and is usually secondary to diseases of the penis or urethra. There are usually considerable pain and edema, and quite a large indurated cord is felt along the dorsum of the penis exactly in the median line. Occasionally suppuration takes place.

TREATMENT.—**Rest, elevation,** and the use of **evaporating lotions** or **mercurial ointment** are usually sufficient.

Varicose Veins.—Varicose conditions of the veins is not uncommon and is of but little clinical significance, although they may occasionally be accompanied by a loss of power of

erection. When large enough to prevent coitus, they may be **ligated** or **excised**.

Balanitis and Posthitis.—Balanitis is an inflammation of the mucous surface of the glans penis, and posthitis an inflammation of the mucous layer of the prepuce. As the two surfaces are usually attacked simultaneously the term **balanoposthitis** is used.

The predisposing cause is a redundant or phimotic foreskin. Because of the retained smegma and urine, the two mucous surfaces are kept constantly moist; they become more or less macerated, offering conditions most favorable for the development of micro-organisms. Diabetes is also said to be a predisposing cause. The exciting causes are irritations, abrasions, contact with endometrial discharges, and chancre and chancroid, gonorrhea and diphtheria.

SYMPTOMS.—In the mild forms there is usually some burning and itching, the mucous membrane is red, somewhat thickened, and a serous pus escapes from beneath the foreskin or covers the surfaces as a milky secretion from which a very offensive odor is emitted. When the inflammation is more intense, superficial erosions and ulcers are seen about the corona. Croupous and diphtheritic varieties of inflammations have been observed, the mucous layers being covered with a membranous coating; it is closely adherent, and the attempt to strip it off is followed by hemorrhage. Among the complications are phimosis, paraphimosis, lymphangitis, and gangrene.

TREATMENT.—Balanoposthitis may be promptly relieved by **cleanliness**. The **prepuce** should be gently re-

tracted, the parts washed freely with Castile soap and warm water twice daily, carefully dried, and dusted with equal parts of bismuth, boric acid, and calomel. It is usually a good plan to interpose a piece of gauze or lint, so that the two inflamed mucous surfaces will not come in contact with each other. Some surgeons prefer lotions or washes. A small piece of cotton is spread out over the surface of the glans penis and moistened with a solution of lead-water and laudanum, or with such a combination as the following:—

℞ *Zinci sulph.* gr. iij (0.2 Gm.).
Plumbi acet. gr. vj (0.4 Gm.).
Morph. sulph. gr. viij (0.45 Gm.).
Aquæ f̄ij (60 c.c.).

Then the prepuce is pulled forward over the glans. In the presence of *erosion or ulcerations* the entire mucous surface should be painted over with a solution of **nitrate of silver** (gr. xx to f̄ij—1.3 Gm. to 30 c.c.).

When complicated by *phimosis*, the inflammatory edema must be counteracted by the frequent use of **hot compresses, lead-water and laudanum, and subpreputial injections**. As soon as the glans can be exposed, the ordinary local treatment as described above is indicated.

In cases of *chronic balanoposthitis*, or when there are frequent acute attacks, **circumcision** is to be recommended.

Herpes Progenitalis.—A condition characterized by the sudden appearance of one or more vesicles on the balanopreputial mucous membrane, surrounded with an erythematous area, and attended by an itching, burning pain.

The predisposing causes are catarrhal diathesis, neuroses, gout, rheu-

matism, and phimosis, and the exciting one is any irritation of the balanopreputial mucous membrane.

SYMPTOMS.—Herpes usually appears suddenly as a cluster of vesicles surrounded by a red areola. These vesicles, at first containing a clear serum, which later becomes cloudy, finally dry up and scab over, leaving a bright-red spot. Occasionally the vesicles rupture, and a true ulcer results, which may become of large size when secondarily infected. Sometimes the lesions are accompanied by a slight burning pain; at other times the pain is intense and neuralgic in character. The pain may precede the development of the vesicles. The disease shows a marked tendency to recur and may occasion a polyganglionic, painless bubo.

DIAGNOSIS.—Herpes must be distinguished from chancre, chancroid, and mucous patches. The chancre usually appears between the tenth and forty-second days; it is single; painless; begins as an erosion, papule, or tubercle, and is indurated, elevated above the surface of the surrounding tissue, shows little or no secretion, and often disappears spontaneously. Dark-stage examination of the secretion would show the *Spirochæta pallida*. Chancroid appears within five days; it may be single, but is usually multiple from autoinoculation; begins as a pustule, always ulcerates, is punched out, secretes profusely, and is often painful. The mucous patch is always accompanied by other manifestations of syphilis.

TREATMENT.—The basis of all treatment is **cleanliness**. The parts should be frequently washed with warm water, each vesicle touched with **nitrate of silver** (gr. xx to f̄ij—1.3 Gm.

to 30 c.c.), and the application of such **powders** and **lotions** as are applicable for balanoposthitis. *When the pain is neuralgic*, a 4 per cent. solution of **cocaine** or a dram (4 Gm.) of **chloral** to the ounce (30 c.c.) of water may be applied. Constitutional treatment should always be directed to the correction of any existing dyscrasia. In *recurrent herpes* **circumcision** is the only means that will bring about a permanent cure.

TUBERCULOSIS OF THE PENIS.—Tuberculosis of the penis is an extremely rare condition. It may be periurethral, balanopreputial, and urethral. The disease, as in other parts of the body, is characterized by the formation of ragged, irregular, undermined ulcers, of very slow growth, and exhibiting little or no tendency to heal. The inguinal glands are often involved, and occasionally undergo caseous changes.

Case of tuberculosis transmitted by ritual circumcision. A healthy child born of healthy parents, breast-fed, developed local symptoms of infection within a few days after the operation and these persisted, being followed after a few weeks by general infection continuing until death. L. Emmett Holt (Jour. Amer. Med. Assoc., July 12, 1913).

Treatment.—When seen early, they should be **curetted**, touched with pure **carbolic acid**, and dressed antiseptically with **iodoform**. Internally, remedies should be administered to correct the existing diathesis. In later stages **amputation** of the organ may be necessary.

The infection of the tubercle bacillus in the male genital apparatus occurs first in the prostate or seminal vesicle and not in the epididymis as others affirm. This was established by necropsy findings. Quinby (Jour.

American Medical Association, Nov. 30, 1918).

TUMORS OF THE PENIS.—

Tumors of the penis may be either benign or malignant, solid or cystic.

The benign tumors include cysts (mucous, sebaceous, or hemorrhagic), adenoma, fibroma, horns, elephantiasis, papillomata, and vascular growths.

The malignant tumors include sarcoma, carcinoma, and epithelioma. With the exception of sebaceous tumors, cysts are rare; the former may occur in any region where sebaceous glands are present.

Adenoma and **fibroma** are exceedingly rare. Guit ras and Beck each report a case. They coincide completely with similar growths in other parts.

Horns springing from the glans have been reported by Brinton and others. They have the appearance of a nail, and when dry are smooth and polished.

Elephantiasis usually involves the penis and scrotum, which organs may attain large size. It is but rarely seen in temperate latitudes. It may result from wounds and diseases which obstruct the lymph-channels.

The treatment of this condition is unsatisfactory. Large doses of **iodide of potash** may be tried. **Circumcision** may be performed so as to remove as much of the thickened skin as possible:

Vascular growths are occasionally found along the dorsal vein and include angiomas and nevi.

The treatment of benign tumors of the penis is that appropriate for like conditions in other parts of the body: **removal** when increasing in size or interfering with function.

Papillomata, venereal warts, or vegetations represent an overgrowth of the papillæ of the balanopreputial mucous membrane. They are usually due to repeated attacks of balanoposthitis superinduced by a redundant or phimotic prepuce in young men who are uncleanly. They are in no sense venereal in origin.

SYMPTOMS.—Venereal warts appear as large or confluent, moist or dry, pedunculous or sessile papillary overgrowths, usually springing from the coronary sulcus, the glans penis, or the inner layer of the prepuce. The confluent warts often assume the shape of a cauliflower. They grow rapidly, are exceedingly vascular, and often attain large size.

A diagnosis must be made from syphilitic condylomata and epithelioma. Syphilitic condylomata are usually associated with other evidences of syphilis. Epithelioma appears late in life, grows slowly, and is markedly indurated.

TREATMENT.—When small and single, these growths may be destroyed by the frequent application of **carbolic** or **chromic acid**. When large, the penis should be covered with **carbolyzed olive oil** (to protect it from acids), the warts rapidly **cut away with scissors**, going well down into healthy tissue and **cauterizing** the base with pure **carbolic acid**. A piece of lint or gauze saturated with a 25 per cent. **boroglyceride solution** should be held in place over the raw surfaces by a **bandage**. When large masses are removed it may be necessary to touch the base with the **actual cautery** in order to control the hemorrhage.

Malignant Disease.—With the exception of epithelioma, malignant dis-

ease of the penis is rare, although malignant tumors are much more commonly observed than the benign varieties.

Epithelioma of the penis may exist in the form of an ulcer or cauliflower-like growth. A redundant prepuce or phimosis predisposing to balanoposthitis, with consequent maceration may act as a predisposing cause.

SYMPTOMS.—The disease usually begins as an insignificant ulcer or wart, located most frequently at the preputial orifice or coronary sulcus. It grows slowly and gradually infiltrates the surrounding tissue. The prepuce is finally destroyed, and an offensive, ichorous discharge covers the ulcer, which shows great tendency to bleed on the slightest manipulation. As the disease extends backward, the cavernous bodies become indurated, the skin adherent, and the inguinal lymphatic glands become enlarged and ulcerate.

There is usually no difficulty in making a diagnosis except in the very earliest stages. Under such circumstances a small section might be removed under cocaine and a microscopic examination made.

The prognosis is exceedingly bad unless the growth is removed very early.

TREATMENT.—**Amputation** or **extirpation** of the penis, depending upon the amount of tissue involved, is indicated. The **infected lymphatics** from both groins should always be **removed** at the time of operation in order to prevent recurrence.

AMPUTATION OF THE PENIS.—Amputation of the penis is indicated for the relief of tuberculosis and malignant disease.

The operation may be performed

either by the flap or circular method; the former, however, is to be preferred. Hemorrhage is to be provided against by transfixing the root of the penis with two long pins, and surrounding the organ with an elastic bandage above. These prevent the ligature from prematurely slipping after the organ has been removed. The position and shape of the flaps are to be governed by the length of the disease. Whenever possible, a long anterior flap is to be preferred.

A narrow-bladed knife is introduced between the cavernous and spongy bodies at a point at least one-half inch behind the disease, and a small posterior flap is then cut forward and downward. From this flap the urethra is to be dissected free. A flap of sufficient length is cut from the dorsum and sides of the penis, reflected backward, and the cavernous bodies divided on a level with the line of reflection. The dorsal artery is now tied, the tourniquet removed, and any spurting vessel ligated with fine catgut. The stumps of the cavernous bodies are now covered by suturing together their fibrous envelopes (tunica albuginea). The anterior flap is punctured, the urethra drawn through it, slit up, and sutured in place. The two flaps are now united with silkworm-gut sutures. A Nélaton catheter should be tied in place for a week, and then a meatal bougie passed at regular intervals to prevent contraction of the new urethral orifice.

EXTIRPATION OF THE PENIS.—Extirpation of the penis is indicated when malignant disease has extended as far back as the scrotum.

The patient should be placed in the lithotomy position, and the scro-

tum split along the entire length of the raphé. After exposing the anterior layer of the triangular ligament, the spongy body is dissected free and cut off, leaving sufficient to bring out through the perineal incision. With an elevator the crura are dissected from the pubic arch; the incision is prolonged about the penis above, the suspensory ligament divided and the dorsal arteries secured. The stump of the spongy body containing the urethra is now slit up, stitched in the posterior part of the scrotal incision, and the external wound is closed. A catheter should be introduced into the bladder and retained in place for a week.

DISEASES OF THE TESTICLES.

ANOMALIES.—**Polyorchism.**—Quite a number of cases have been reported of men who have three, four, or six testicles, but only in a very few authentic cases has the anomaly been verified by *post mortem* or operation. In some of the supposed cases tumors, hernias, and hydroceles have been found.

Anorchism.—Congenital absence of the testicles has been occasionally reported, but on dissection in many of these cases abdominal retention of the organs was noted. The condition is not so uncommon as a unilateral deformity (monorchism). The pelvic portion of the vas and the seminal vesicle are usually present, although the prostate is rudimentary on the corresponding side. In a true case of anorchism the voice does not change, there is no beard, sexual organs are rudimentary, and impotence is the rule. These facts might assist in distinguishing between abdominal retention and ab-

sence, as in the former all the characteristics of the male sex are preserved. It may be sometimes difficult to distinguish absence from atrophy of the organs.

TREATMENT.—When the testicles are absent it might be possible to favor the proper development of the individual by injections or ingestion of the **organic extracts (testicular)**.

Synorchism.—Fusion of the testicle has been reported by Baillie and Schurig. In each instance two cords were found.

Hypertrophy of the Testicles.—The size of the testicle bears no relation to the size of the individual. Compensatory hypertrophy is believed to occur when one testicle has been removed. As large organs are more vulnerable than the small, they should be supported by a **suspensory bandage** and the subject cautioned as to the dangers of urethritis.

Atrophy of the Testicles.—True atrophy is always observed in cases of undescended testicle. Even in the normal position one or both may remain rudimentary. They often regain their normal size as the result of physiological activity. Unilateral atrophy frequently follows metastatic inflammations from mumps, pressure from large varicoceles and herniæ. There is no reason to believe that prolonged chastity causes wasting of the organs.

But little can be done for these cases. **Misplacements** should be **corrected**, and **massage** may be tried.

Undescended Testicle.—The testicle may be arrested in any part of its course in its descent from the kidney to the scrotum; when retained in the abdomen, it is termed cryptorchidism. It is sometimes found in the

groin and in the perineum. The cause of these abnormalities has been variously attributed to small rings, a short cord, peritoneal adhesions, and loss of power or anomalous attachments of the gubernaculum.

Misplaced testicles, as a rule, are undersized, and there is a degeneration and atrophy of the secreting structure. They are often functionless, and sterility results. In some of the reported cases spermatozoa were found. When misplaced outside of the abdomen, the testicles are exceedingly liable to injury, and inflammations and malignant degeneration are common.

Retention of the testicles is a congenital defect. It seldom occurs alone, but with other malformations or developmental defects. The retained testicle in itself does not cause disturbance, but complications are frequent, especially hernia and torsion. Uffreduzzi (*Archiv f. klin. Chir.*, ci, No. 1, 1913).

DIAGNOSIS.—When the testicle is retained in the inguinal canal it must be distinguished from hernia, which can usually easily be done by noting the absence of the testicle from the scrotum, ovoid shape, irreducibility, and the sickening pain when pressed upon. When situated in the region of the groin, it may be confused with bubo, especially when orchitis is present. The same rules, however, hold good as in the case of hernia.

TREATMENT.—When the organ still remains *in the abdomen*, nothing can be done by surgical intervention; its attachments, being necessarily short, would prevent its being dragged down into the scrotum. When situated *in the inguinal canal*, an effort should be made to bring it into the scrotum by daily **traction**, its return

into the canal being prevented by the use of a truss having a very soft pad. If it cannot be drawn down into the scrotum by the sixth year, operation is necessary (**orchidopexy**). The gland is exposed by a free incision, and brought out of the wound, so that the fibers of the cremaster may be divided transversely. The cord is then gently stretched until the testicle hangs free beyond the external abdominal ring. The scrotum is now invaginated and fastened to the base of the testicle by three catgut or silk sutures. When the invaginated scrotum is drawn out, the anchored testicle is carried into its proper place. The deeper tissues are closed by catgut, and the tissues of the cord are sutured to the pillars of the external ring.

Probably the most satisfactory operation for the relief of this condition is **Bevan's operation**:—

1. Incision.
2. Laying open of the inguinal canal.
3. Exposure of peritoneal pouch.
4. Division of cremaster muscle and fascia and transversalis fascia overlying it.
5. Transverse division of the sac (tunica) and ligation of upper end as in hernia operation.
6. Purse-string closure of lower end to form a new tunica vaginalis testis.
7. Gauze dissection of peritoneum from cord, including vas and vessels, leaving these structures alone undivided.
8. Preparation of pocket or pouch and placing the testicle in the scrotum and retaining it there by a purse-string at the base of the scrotum.
9. Closure of the canal by the Bassini method, omitting transplantation of the cord, completes the operation.

In a few cases where sufficient lengthening is not obtained by freeing the cord to place the testicle well down in the scrotum a division of the spermatic vesicle is indicated.

The writer has operated on 18 patients by the **Bevan method**. Primary union resulted in every instance; there is no recurrence of the hernia; the testicle is freely movable and in the very bottom of the scrotum. In other words, he says, all these patients can be legitimately regarded as completely cured, so far as the descent of the testicle and the hernia is concerned. Moschcowitz (*Amer. Jour. Med. Sci.*, Dec., 1910).

In **Walther's operation** for undescended testicle, the spermatic cord is mobilized as far up as possible, and the testicle is drawn down and slipped into the other half of the scrotum through a small slit made for it in the septum. The slit is then sutured on each side of the spermatic cord, so that the testicle is held firmly in its new bed by the elastic force of the septum. He leaves the cord entirely free; the traction from the testicle below gradually stretches it. The testicle itself is also left free in its new bed. In 13 of the patients recently re-examined after an interval of months to over 9 years, the results were excellent. C. Walther and C. Monod (*Bull. de l'Acad. de Méd.*, March 12, 1912).

In the older literature too much importance was laid on malignant change which later study shows is less frequent than was supposed, and nearly always occurs in inguinal retention where the greater exposure to trauma explains the greater susceptibility. The histology of the undescended organ varies within wide limits, from those with but few signs of disturbed development to those consisting largely of edematous fibrous interstitial tissue. The normal changes of puberty seem delayed in the undescended gland and, with an imperfect development of the genital organs in the embryonic life,

there is but little chance of betterment. There are other conditions in which the organ retains its infantile condition, and there are still others in which the changes of puberty occur, but senile atrophy appears early unless the testicle is brought into its normal position. Whether a gland of the infantile type will develop the adult characteristics is uncertain, but it is probable that spermatogenesis if developed lasts only for a short time. It is important to transplant such testicles before puberty if there is any good to be obtained. After puberty even, in most cases transplantation does not cause further development, but it does in some. The obstacles of placing the gland in the scrotum consist in adhesions and tortuosity of the spermatic vessels, and unless the structural shortening of the cord is overcome no fixation will retain it in its proper place. The final success of the **Bevan operation** depends on the great factor of safety provided in the blood-supply of the testicle. Either the spermatic or the deferential artery alone seems able to supply sufficient nourishment, and when the short spermatic vessels make a persistent obstacle to successful transplantation, they may be divided without affecting the function. The writer describes the operation, which he has used in 16 cases with good immediate results and with ultimate satisfactory results for periods from three months to seven years. A. McGlannan (Jour. Amer. Med. Assoc., Feb. 28, 1914).

In **Thompson's operation**, the exposure of the external opening of the inguinal canal, the incision commences just internal to the anterior superior spine, and proceeds in a sinuous manner into the scrotum. The first part lies half an inch above, and parallel with, the outer half of Poupart's ligament. The second part is curved with its convexity directed downward and outward. It begins just above the middle of Poupart's ligament and terminates near the

pubic spine. The third part curves downward into the scrotum, and is of equal length to each of the two other parts of the incision. Its convexity is directed upward and inward. The external ring is exposed and any hernia treated in the usual way. The vas is isolated with its accompanying artery and vein. The cremasteric plexus of blood-vessels and lymphatics is removed between ligatures.

A finger is introduced into the cavity of the scrotum and the testicle is brought down and placed in the scrotum, in which it is retained by an assistant. The extremities of the middle part of the incision are then united by a curved incision whose convexity is directed upward and inward, and an oval flap of skin and subcutaneous tissues, extending down to the external oblique muscle, is dissected and isolated. This oval flap is then transferred to the scrotal part of the incision and sutured to both sides of this part, so that its lower apex lies in the lowest part of the scrotal portion of the incision. The rest of the wound is then sewed up in the usual way. By this means the scrotum is appreciably enlarged and, as it were, stiffened by a portion of tissue which contains no "dartos" muscle, and therefore remains uncontracted. Thompson (Lancet, May 30, 1914).

In the *femoral variety* of misplacement, the **testicle** should be **returned to the abdominal cavity** and **held in place by a truss**. In the *perineal form*, the **operation for inguinal displacement** can occasionally be done.

When seen late in life, **castration** is always advisable, as the organ is probably functionally useless, and is liable to sarcomatous degeneration.

Inversion of the Testicle.—The testicle may have descended to the base of the scrotum, and then assumed various faulty positions (anterior, lateral, horizontal, and rotary), the horizontal being the most common.

Luxation of the Testicle.—The testicle may be luxated from its normal position by blows, muscular action, and sudden contraction of the cremaster. It usually becomes rapidly inflamed and atrophy is frequent.

VARIETIES. — (1) Abdominal; (2) Crural; (3) Perineal; (4) Penile; (5) Inguinal.

TREATMENT.—When seen early the luxation should be reduced by **manipulation** and **traction**, a **pad** being applied **over** the **external ring**. When adhesions have formed, as in old unreduced cases, the **operation** for **undescended testicle** may be required.

Torsion of the Testicle.—The cord of an undescended testicle may be twisted as the result of congenital malformations. The symptoms depend upon the amount of torsion. There is usually inflammation and possible gangrene. This condition must be distinguished from strangulated hernia and epididymitis. In torsion the epididymis is anterior, while in *epididymitis* it is posterior. In a *hernia* there is an impulse on coughing and obstructive symptoms are present. *Simple orchitis* is to be distinguished by the normal anatomical arrangements of the parts.

TREATMENT.—*When seen early* the torsion is to be reduced by **manipulation** and **lead-water** and **laudanum** applied, with **elevation** and **rest in bed**. *After adhesions have formed* the **testicle** and **cord** must be **exposed**, the **twist** reduced, and the **testicle** secured in **proper position** by a few sutures on one side. Gangrene requires **castration**.

INJURIES OF THE TESTICLE.—When normally situated, the testicle is not often injured. Contusion from kicks, blows, and bruises upon

the saddle are not uncommon. There are usually an acute sickening pain, often faintness or syncope, followed by rapid swelling. An hematocele or inflammation may ensue, followed by hydrocele and fibroid changes in the organ.

Incised, punctured, and gunshot wounds are occasionally met with, and require the same treatment as similar wounds of other parts of the body. Such wounds usually do well, and castration is seldom or never called for.

ORCHITIS.—An inflammation of the testicle is caused by gonorrhea, mumps, tonsillitis, tuberculosis, syphilis, and traumatism.

SYMPTOMS.—The symptoms of the simple inflammatory variety are as follows: Dull, sickening pain, radiating toward the hips and back; the testicle rapidly swells, but retains its ovoid form. Occasionally an acute hydrocele develops, and as a result there is an increase in swelling and pain. Occasionally suppuration takes place.

DIAGNOSIS.—Orchitis must be distinguished from *epididymitis*, which can be readily done by noting the position of the tenderness, this being posterior when the epididymis is involved.

TREATMENT.—The patient should be confined to **bed**, the **scrotum elevated**, and **applications** of **lead-water** and **laudanum** made. The bowels must be **kept open** and the pain controlled by **morphine**. *In the presence of an acute hydrocele*, **puncture** of the **tunica vaginalis** with a fine **tenotome** will often instantly relieve the pain. *After the acute symptoms have subsided* resolution may be hastened by **strapping** or the application of **mer-**

curial and **belladonna** ointments. Should an **abscess** form, it should be **opened** early, and treated on general principles.

Tuberculous Orchitis.—Tuberculous orchitis is usually secondary to a like affection of the epididymis; the organisms, however, may reach the gland through the blood, and a primary focus develop. The disease is often bilateral, and is most commonly met with between the ages of 25 and 35.

SYMPTOMS.—The organ becomes hard, knotty, and irregular; there is a feeling of dragging weight and a sense of discomfort referable to the back. Sooner or later inflamed tissues become adherent to the skin, soften, break down, and rupture spontaneously, leaving fistulous openings, which exhibit little or no tendency to heal. There is little or no pain in the early stages of the disease. Not infrequently the disease has been preceded by tuberculosis of the lungs. Tuberculous testicle must be distinguished from *syphilitic orchitis*. The syphilitic is uniform, hard, painless, and seldom or never suppurates.

In not a few cases resolution takes place. The disease may become encapsulated and cause no further trouble. In bad cases it may involve the epididymis, vas, prostate, and bladder.

TREATMENT.—The routine treatment consists in the internal use of **iodide of iron** and **codliver oil**, with **good food**, **fresh air**, and **sunlight**. *Locally*, the part should be kept at **rest**, and **iodide of lead ointment** applied. Should the disease progress, injections of **chloride of zinc**, from 3 to 5 drops of a 1 per cent. solution, may be made around the periphery of the

focus every third or fourth day. A 10 per cent. emulsion of **iodoform** and **glycerin** may be used in the same manner, from 20 to 30 drops being used at each injection. *When the disease is circumscribed*, it may be **curetted** and touched with pure **carbolic acid**. Such a procedure will destroy the function of the organ. **Castration** is indicated when other measures have failed.

Metastatic Orchitis.—This is a frequent complication of mumps. One testicle is usually involved, and atrophic changes are exceedingly common. The symptoms and treatment are similar to acute orchitis.

During the first six days the following ointment should be rubbed in gently:—

℞ *Guaiacol* ʒiiss (10 Gm.).
Lard ʒij (60 Gm.).

Envelop the testicles in cotton and support them in a **suspensory bandage**.

At the end of the first week apply the following ointment:—

℞ *Mercurial ointment*,
Belladonna ointment,
Ichthyol,
Wool-fat ..of each ʒj (4 Gm.).—M.
 (Bull. gén. de thérap.; Monthly Cyclo., April, 1908.)

The following ointment may be rubbed into the skin:—

℞ *Synthetic guaiacol*. ʒiiss 10 Gm.).
Methyl salicylate . ʒiv (16 Gm.).
Lard ʒiij (90 Gm.).

(Jour. de méd. de Paris, Oct. 24, 1908.)

Case of unilateral orchitis, apparently originating by metastasis from primary foci in inflamed tonsils, in which **hexamethylenamine** in doses of 15 grains (1 Gm.) every 6 hours, later reduced to 5 grains (0.33 Gm.), brought about rapid improvement. Prouty. (Jour. Amer. Med. Assoc., April 20, 1912).

Two cases of orchitis due to parotitis on which the writer operated with the view of preventing, if possible, the atrophy which so frequently follows this affection. The method employed was based upon the theory that atrophy results from the increased intratesticular pressure caused by the inflammation. Relief of this tension obtained by **slitting the tunica albuginea** restores the circulation and preserves the testicle. G. G. Smith (Boston Med. and Surg. Jour., Sept. 5, 1912).

Syphilitic Orchitis.—This condition usually occurs as a complication of the third stage of syphilis. The testicle is hard, indurated, somewhat irregular, and painless. Both testicles are often involved.

TREATMENT.—Mixed treatment, **biniodide of mercury**, $\frac{1}{12}$ grain (0.005 Gm.), with 20 grains (1.3 Gm.) of **iodide of potassium**, should be administered thrice daily. *Locally*, inunctions of **mercurial ointment** are used.

TUMORS OF THE TESTICLES.—Tumors of the testicles are rather uncommon, but cysts, adenomata, fibromata, chondromata, myxomata, carcinomata, sarcomata, and dermoids are occasionally met with. Cancer is by far the most common tumor affecting the testicle.

Symptoms.—Carcinoma is usually unilateral, making its appearance about middle life as a uniform swelling; the encephaloid grows rapidly, becoming nodular and irregular, and quickly breaking down and ulcerating, leaving a protruding fungous mass. The scirrhus occurs in older individuals, and is of slow growth. As the disease progresses, the inguinal lymphatics become involved and also the lumbar. The general health rapidly fails, the face becomes cachectic, and the body emaciated.

In the last stages cancer might be mistaken for tubercle. However, the age, rapid growth, and ulceration would all point to malignant disease.

Treatment.—Early and complete **extirpation** is alone indicated.

HYDROCELE.—This is a collection of fluid in the tunica vaginalis. It may be acute, as the result of extension of inflammation from either the epididymis or testicle; congenital,—the result of anatomical deficiency in the vaginal and funicular processes; or it may be encysted. In many cases, however, the cause is not appreciable, although it is probable that traumatism and strains may favor its development.

In the acute variety of hydrocele, owing to the prominence of the symptoms of the primary condition, the characteristic symptoms are not pronounced. Pain is agonizing and is due to pressure. In the encysted form swelling, of slow formation, beginning at base of the scrotum and which is pyriform in shape, smooth, tense, fluctuating, and elastic on pressure, is noticeable; this does not, however, alter the size of the organ, which is dull on percussion, stands away from the body, and cannot be reduced. In the congenital variety the swelling is also of slow formation, dull on percussion, filling from below; it disappears when the patient assumes the recumbent posture, but returns slowly when he is in the erect posture. Such hydroceles are frequently complicated by hernia.

Diagnosis.—Hydrocele must be distinguished from *hernia*, *varicocele*, and *hematocele*. This can usually be done by the "light test." The patient should be examined in a dark room; a candle or lamp is held close to the

scrotum, and by looking through the scrotum toward the light the swelling will appear translucent and at the same time the position of the testicle will be observed. This test may fail in thick-walled sacs.

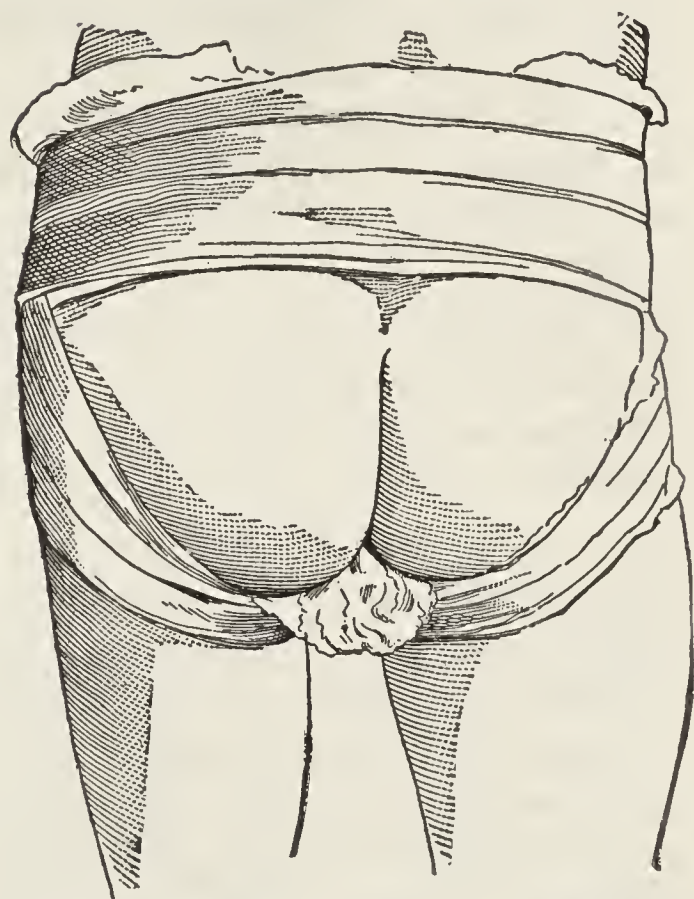
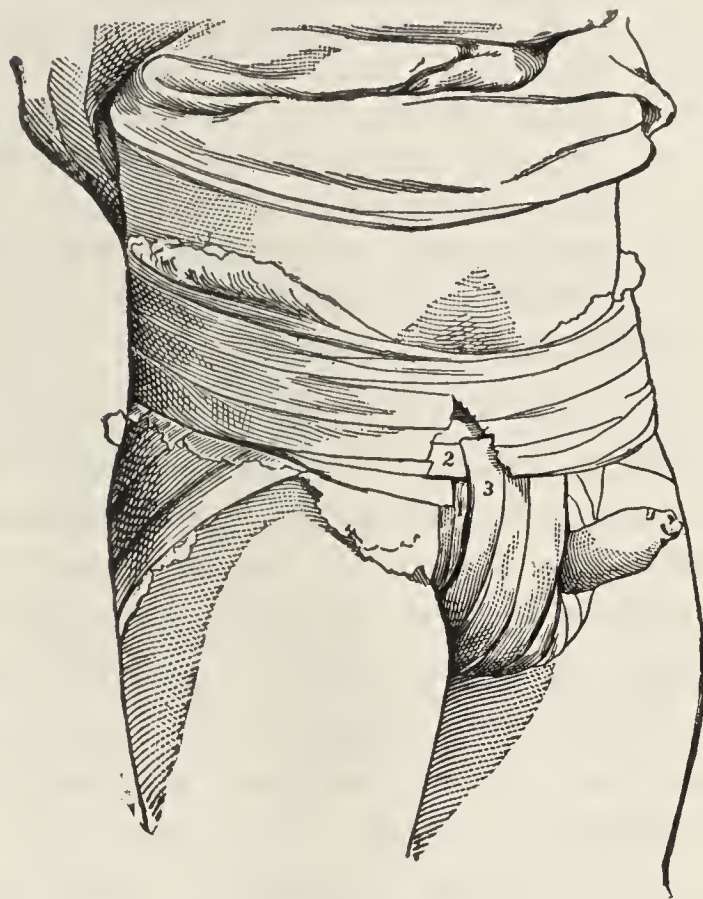
Treatment.—In the *acute form* rest in bed, elevation of the scrotum, and application of lead-water and laudanum are indicated. When the pain becomes very severe, the sac may be punctured. After the acute symptoms have subsided, a well-fitting suspensory should be worn.

In the *encysted variety* treatment may be either palliative or radical. The *palliative* consists in tapping with trocar and cannula, drawing off the fluid, repeating the operation as often as the sac refills. In *tapping* a hydrocele the swelling is made tense, and the trocar is plunged in with a firm, quick, boring motion, being careful not to wound the testicle. A spot should always be selected on the scrotum free from veins, so as to avoid the possibility of hemorrhage into the loose cellular tissue.

The writer used with great satisfaction a **vaccine** containing from five to ten million of *Bacillus pyocyaneus* or *Staphylococcus pyogenes aureus* after tapping the hydrocele (in some cases without tapping). The injection of this vaccine into the sac caused a severe inflammation lasting seven days; when the inflammation subsides the scrotum becomes reduced in size and the hydrocele is cured. Mallavnah (Brit. Med. Jour., Jan. 27, 1912).

Autoserotherapy is a simple, easy and harmless method found effectual by the writer in 45 per cent. of the cases in which he applied it, the outcome depending in large measure on the age and pathology of the hydrocele. In 4 bilateral cases he aspirated a few c.c. of the fluid on one

side alone and reinjected it, the hydrocele on both sides retrogressed. L. Caforio (Riforma Medica, Sept. 14, 1912).



Compression bandage for scrotum. (Wickham.)
(La France médicale.)

The writer recommends highly the **Gomoiu** and **Phocas** operation. An inguinal or inguinopubic incision 2 to 4 cm. long is made. By pressure from the scrotum, the tunica vaginalis appears between the lips of the

wound. Two forceps being placed on its wall, the contents of the vaginal sac are evacuated through an incision. The testicle and its envelopes are then drawn through the wound and dealt with according to the state of the serosa, which may necessitate a partial resection of the parietal fold. The reaction in the scrotum is less than after a scrotal incision; the patient is kept in bed but a few days. Tourneux (*Prog. Méd.*, Feb. 20, 1916).

The *radical treatment* may be carried out either by injections of irritating fluids or cutting operations. In the **injection** method, pure **tincture of iodine** is thrown into the sac after the withdrawal of the fluid. From a dram to an ounce (4 to 30 c.c.) may be used, according to the capacity of the sac. This method is especially valuable in thin-walled hydroceles.

The cutting operations include the open method, **Volkmann's operation**, removal of the parietal layer of the sac, **von Bergmann's operation**, and the **Jaboulay** or **Winkelman's operation**—splitting the sac and turning it inside out, folding it above the testicle and cord, and so stretched that the endothelial lining is in contact with the new connective tissue of the scrotum. In the first the tissues of the scrotum and sac are incised, the sac sutured to the skin to prevent adhesions, and the cavity of the tunica vaginalis packed with iodoform gauze to promote healing from the bottom. In the second the parietal layer of the sac is removed through an incision of sufficient length, and the wound closed. These methods are preferable when the iodine method has failed or when the wall of the sac is thick.

Congenital cases can occasionally be cured by the application of a **truss**. If this fails, an **antiseptic seton** will usually prove successful.

SPERMATOCELE.—A collection of milky fluid in the tunica vaginalis containing spermatozoa gives rise to symptoms similar to hydrocele. This term is also applied to cysts usually situated between the testicle and epididymis. It is caused by dilatation of the vasa efferentia. They may vary in size from a pea to an orange. The treatment is the same as that for hydrocele.

HEMATOCELE.—This is a collection of blood in the tunica vaginalis, which may either be due to traumatism, disease, or occur as a sequel to the tapping operation for hydrocele.

The scrotum assumes a globular shape, the largest circumference being below. The tumor does not fluctuate and does not transmit light. Being abnormally heavy, it is unusually low.

Treatment.—**Rest in bed**, **elevation of the scrotum**, and the application of **lead-water** and **laudanum** are first indicated. After the acute symptoms have subsided, the **scrotum** should be **strapped**. When these measures fail, the **tunica vaginalis** should be **opened**, all **clots** turned out, and an **iodoform-gauze** packing introduced.

VARICOCELE.—This condition is due to dilatation, thickening, or tortuosity of the veins of the pampiniform plexus. It is most frequently observed in young men, is usually located on the left side, because the left testicle is the lower, and also owing to the fact that while the left spermatic vein opens into the renal vein at right angles and has no valves, the right spermatic vein opens obliquely into the vena cava and is supplied with valves. It may occur on either side at any time during life. It is caused by sexual abstinence,

pressure by a truss, abdominal tumors, arteriosclerosis, etc.

Diagnosis.—Varicocele is easily recognized, the vein, when the testicle is grasped gently and palpated, feeling like a bag of earth-worms. It disappears on lying down and refills from below when the patient stands and the external ring is compressed. Coughing also causes a slight impulse in the varicocele.

Investigation of the results of operation in 39 cases, the data being obtained 1 to 10 years after operation: 36 per cent. still had pain in the testicle or groin, 31 per cent. had tenderness in the testicle, 27 per cent. had sexual hypochondriasis. No atrophy of testis resulted from operation. Recurrence in 6 per cent. **Operation** was acknowledged as distinctly beneficial in 80 per cent. J. D. Barney (Boston Med. and Surg. Jour., March 17, 1910).

Three cases observed in Cairo, Egypt, which presented the usual clinical signs and symptoms of varicocele, but in which the swelling was due to the presence of tortuous coils of very thin-walled, dilated lymphatics in the substance of the spermatic cord. This condition, the writer believes, is a manifestation of filariasis, though he has not succeeded in finding filarial embryos in the blood. F. C. Madden (Lancet, Jan. 6, 1912).

Treatment.—A suspensory bandage and applications of cold water night and morning often suffice.

When the varicocele is a source of anxiety, an **incision** is made over the **external inguinal ring**; **separation** of the **vein** from the **vas** and **tying** of its **vessels** are then practised. The veins may be further separated almost to the epididymis, by drawing up the testicle into the wound and a second ligature applied. The **mass** is then **excised** and if the cord be very long

the **cremaster muscle** is **shortened**. The inguinal canal is sometimes found dilated by the varicocele; in that case **obliteration** is indicated as in the **Bassini operation**; otherwise, removal of the veins would leave an open canal.

To cure varicocele it is seldom necessary to open the tunica vaginalis or to resect the enlarged veins. The writer prefers the **Goodnight operation**, which is a simple **shortening** of the **scrotum**, and is performed in the following manner: Push the testicles high up in the scrotum and place a clamp across the scrotum just below the testicles in their high position. Cut away with sharp scissors or knife all the scrotum below the clamp. Release the clamp and pick and ligate all bleeding points with catgut. It will be observed when the clamp is removed that the tunica vaginalis has not been opened. Close the wound with interrupted silkworm-gut sutures. This will hold the testicles up permanently and take the weight off the cord, and does permanently relieve varicocele. If it is necessary in extreme cases, or where there is a hydrocele present, the tunica vaginalis can easily be opened through this incision, and it will not be found necessary to open higher up. R. O. Braswell (Med. Review, Jan., 1914).

The conventional operation (**resection of the pampiniform plexus and approximation of the two ends**) according to the writer possesses the great disadvantage that it not uncommonly causes degeneration of the testis. He has devised the following **operation** to obviate this: Inguinal incision; dislocation of the testicle through the wound and division of the Hunter ligament, so called, which fixes the testicle to the bottom of the scrotum; a narrow flap of fascia made from the aponeurosis of the external oblique is then formed with base downward; this is turned down into the scrotum and

sutured to the divided Hunter ligament; closure of the wound. In this operation, as is obvious, the testis is turned upside downward. The author's results have been excellent both functionally and cosmetically. R. Frank (Amer. Jour. of Surg., from Zentralbl. f. Chir., April 4, 1914).

EPIDIDYMITIS.—Inflammation of the epididymis may be inflammatory, syphilitic, or tuberculous. It commonly results from the extension of gonorrheal inflammations from the posterior urethra through the vas, but is sometimes due to syphilis and tuberculosis.

Summary of 100 cases of gonorrheal epididymitis treated in the St. Louis Hospital. Epididymitis is a frequent complication of gonorrheal urethritis, very painful, and liable to result in sterility, with the possibility of infection of others. The mode of entrance of the germ into the epididymis is through the ejaculatory duct and vas deferens, as the result of retroperistalsis. Predisposing causes are trauma, instrumentation, lack of suspension of the scrotum, sexual intercourse, and masturbation. Sterility in bilateral epididymitis occurs in a very large percentage of cases. C. M. Walson (Med. Rec., June 3, 1911).

Two cases of acute epididymitis resulting from severe muscular effort. Most careful examination of the urine, prostatic secretion, and a thorough urethroscopic inspection of the entire urethra in each case completely excluded the possibility of a gonorrheal infection, either acute or chronic. The condition has been reported before and has been attributed to the sudden violent contraction of the cremaster. This muscle is too weak to do this; the explanation does not suffice. The explanation is to be found in the anatomy of the veins supplying the cord and testicle. They are long and have few valves. Marked increase in the pressure in them, due to forced expiratory effort

in the course of violent strain, together with the actual pinching off of their outlets at the ring, would be sufficient to cause a rupture of some of their smaller branches. Edwards (Brit. Med. Jour., April 13, 1912).

Bilateral tuberculous epididymitis is less liable to entail azoöstermia than the gonorrheal. His experience in more than a thousand cases of azoöstermia has been that it is incurable in about 80 per cent. of the bilateral gonorrheal cases; others have reported still higher percentages. On the other hand, the anatomical conditions with a tuberculous process may leave the passage partly permeable. P. W. Fürbringer (Deut. med. Woch., July 17, 1913).

Epididymitis following a cystitis in which the *Bacillus coli* was demonstrated in pure culture. There was no urethritis. The exudate was very slow in subsiding. W. S. Reynolds (Amer. Jour. Med. Sci., July, 1913).

Meningococcic epididymitis developed 46, 23 and 15 days after the onset of severe epidemic meningitis. There was slight fever in only 1 of the 3 cases, and the epididymitis subsided without apparently leaving a trace. While it lasted the features closely resembled those of the gonorrheal type. The true meningococcus was cultivated from one and paremeningococci from the others. Lancelin (Bull. de la Soc. Méd. des Hôp. de Paris, Oct. 19, 1917).

Symptoms.—These are of the *inflammatory type*: tenderness along the cord, hard swollen vas, and pain in the back. The testicle rapidly swells, and becomes exceedingly tender, the patient walking with a stooping posture and the legs wide apart. When the inflammation is at its height general malaise, anorexia, and fever of 100° F. (37.8° C.) or over may be included in the clinical picture. On examination the tenderness and swelling will be found confined

to the posterior part of the scrotum. An acute hydrocele by contiguity may result. Suppuration is rare, the general tendency being always toward resolution. Traces of the attack often remain for a long time after the inflammation has subsided, the regular outline of the organ being interrupted by masses of lymph. In about 60 per cent. of the cases of double epididymitis the patient remains sterile. *For the relief of sterility*, **Martin** has successfully suggested an **operation** which consists in exposing the vas and the epididymis. A prominent bunch of tubules of the epididymis is incised and if found to contain living spermatozoa the vas is incised and an anastomosis made between the two organs at that point.

The *syphilitic* variety is usually noted as a complication of the secondary period, and consists of small, gummatous lesions.

The *tuberculous* variety may be primary, but is often secondary to that of the testicle or prostate. The disease usually begins in the head of the organ as a series of nodules, of slow growth, which become adherent to the skin, soften, and leave a fistulous opening. This form is usually followed by sterility on the affected side.

Treatment.—In the *simple inflammatory form* **rest in bed, elevation of scrotum, and lead-water and laudanum or hot fomentations** are indicated. The application of an ice-bag will greatly relieve the pain, it increases the induration, and in my experience is a frequent cause of suppuration by devitalizing the part.

The writer recommends the following treatment in gonorrheal epididymitis: Where preliminary pain at external abdominal ring (vasitis),

put patient to bed and support scrotum by strip of adhesive stretched over anterior surfaces of thighs. For established epididymitis, support scrotum in same way, and apply to it the following ointment: *Mentholis*, gr. xv (1 Gm.); *ung. belladonnæ*, gr. xx (1.3 Gm.); *ung. Credé*, gr. xxx (2 Gm.); *ichthyolis*, 3j (4 Gm.); *petrolati*, q. s. ad 3j (32 Gm.). If swelling of epididymis does not quickly resolve, **strap testicle**, as follows: Envelop affected half of scrotum in a square of gauze. Press testicle into bottom of scrotum with thumb and index finger and bind a strip of adhesive above organ, holding it down. Then pass other strips, starting at the first one, around under testicle and up the opposite side until organ is covered. Finally, secure with another transverse strip over the first. Support with **suspensory**. Renew strapping every other day. Bethune. (Buffalo Med. Jour., Nov., 1911).

In gonococcal epididymitis the writer applied **hot poultices** of 2 per cent. **aluminum acetate**, as hot as could be borne, renewed every quarter- or half- hour. As compared with groups of cases treated by 12 different methods, the hot poultices gave the best results in every instance. Nakano (Zeit. f. Urol., July, 1913).

Bier's method in gonorrheal epididymitis may be used by first passing a strip of lint bandage around the cord on the affected side, just above the testicle. This is continued along the median raphé between the two testicles, and over it is applied a piece of fine rubber tubing, which is then tightened until no pain results after its application. It is held by artery clamps, and allowed to remain *in situ*, usually for an hour on the first day, increasing up to as long as eight hours a day toward the end of the treatment. The treatment causes immediate relief of pain, such that the patient is often enabled to return to work in less than two days after the first application. It is well

to continue all of the usual measures employed. The method also shortens the course of treatment from the usual 10 days to 2 or more weeks down to from 4 to 10, or 12 days. It is applicable to all chronic and to most of the acute cases. A. C. Wilson (Brit. Med. Jour., Nov. 15, 1913).

When the pain is severe, the acute **hydrocele** may be **punctured**. In the very severe cases, and especially those which do not undergo prompt resolution, it may be necessary to perform **epididymotomy**. The operation of epididymotomy after my method consists in the administration of gas anesthesia and plunging a very fine, straight, sharp-pointed bistoury from the base of the epididymis to the top; this is usually followed by the escape of blood and small areas of purulent collection, thus relieving the pain almost instantly. **Antiseptic dressing** applied and the testicle kept surrounded with **hot normal salt solution**. Resolution usually takes place promptly.

In cases of severe inflammations of the epididymis, the writer advises the **operation** originated by **Hagner**. It is done under general anesthesia. An incision is made through the skin of the scrotum exposing the tunica vaginalis, which is opened at the junction of the epididymis and testicle. The fluid contained is evacuated, and the enlarged epididymis examined through the wound. The testicle and epididymis are delivered through the wound and enveloped in warm towels. Multiple punctures are made through the fibrous covering of the epididymis with a tenotome, especially over the portions where the enlargement and thickening is greatest. The knife should penetrate the thickened fibrous capsule and enter the infiltrated connective tissue. If pus is seen escaping from any of the punctures, the opening should be enlarged and a

small probe inserted in the direction from which the pus flows. After the small abscess has been explored with a probe, the **pus** should be **evacuated** by light pressure over its surface, and its **cavity washed out** with a fine-pointed syringe and a **solution of mercury bichloride 1:1000**, followed by a **normal salt solution**. The **incision in the tunica vaginalis** should be lightly closed with a **running cat-gut suture**; a **cigarette drain** of gauze is then applied over the incision, and the skin brought together by a **subcutaneous suture**. **Gauze dressings** are applied and the **part supported by a wide T-bandage**. The second day after the operation the gauze drain is removed and the wound redressed, and, as a rule, the patient is allowed to get out of bed and walk about a week after the operation. H. H. Morton (L. I. Med. Jour., March, 1910).

A single puncture cannot exert a lasting influence on the course of an epididymitis, and multiple punctures are generally contraindicated because it is not desirable to repeatedly injure so important an organ as the epididymis. Fruehwald (Münch. med. Woch., Oct. 11, 1910).

The writer found **incision** into the epididymis preferable to puncture, which, as a rule, affords only temporary relief. The incision is made under local or general anesthesia, the epididymis exposed and any collection of **pus evacuated by puncture**. This is followed by irrigation of the **abscess with 1 per cent. sublimate solution**, and of the **tunica vaginalis with a weaker antiseptic fluid**. Occasionally **indurated nodules** may have to be **excised**. Mere puncture is considered only a palliative measure. The special indications for incision are severe phlegmonous inflammations with intense pain, high fever, or recurrent epididymitis with the formation of fibrous masses. M. Lance (Gaz. des Hôp., No. 47, 1911).

Orchidectomy is no more curative than **epidymectomy**, and, except in

rare instances, is an unjustifiable procedure; 76 per cent. of 71 cases operated on are now in good condition. Barney (Boston Med. and Surg. Jour., March 14, 1912).

In acute epididymitis **aspiratory puncture** is recommended. The writer uses **ethyl chloride** and in very sensitive patients, **novocaine**. He then thrusts a very sharp, fairly large needle attached to a 10 c.c. syringe into the inflamed epididymis, and aspirates the contents. Usually 2 or 3 punctures are made at different points. Although painful, the relief of pain is almost immediate, and within 6 to 12 hours the swelling and fever are diminished considerably. Walther (Med. Rec., Oct. 2, 1915).

The writer obtained excellent results from 30 Gm. (1 ounce) of **calcium salt solution** injected intravenously. After injection, pain disappeared. No induration was left. Murata (Sei-I-Kwai Med. Jour., Oct., 1915).

In the case of a man of 24, who had a fistulous epididymitis, the writer used local injections of Durante's **iodo-iodide solution** (a mixture of **iodine** 1 part, **potassium iodide** 3 parts, and distilled water 100 parts) every fourth day and a subcutaneous dose every day. The cure was almost complete by the end of 1½ years. Sofia (Policlinico, Jan. 7, 1917).

The writer operated on 276 patients at Fort Sam Houston, the average time in hospital being 10 days. Technique of **Cook's operation** varies from the usual bottle operation for hydrocele only in that the globus minor is punctured several times with a cataract knife and if pus is found a small rubber tissue drain is inserted. The skin is closed with 2 mattress sutures taken about one-fourth of an inch from the cut edges and pulled up tight. Drains are removed in 48 hours, sutures in 6 days. Cook (Jour. Amer. Med. Assoc., lxx, 981, 1918).

The **Wagner** operation is much too severe to be considered except in rare instances, because this operation requires an incision in which

the testicle is removed from the scrotum and a trocar passed up through the epididymis. The after-treatment is the same. After the acute symptoms have subsided, the testicle should be **strapped** and small doses of **iodide of potassium** should be given internally to favor resolution.

The *syphilitic form* requires the **mixed treatment** internally, combined with inunctions of **mercurial ointment**. The *tuberculous type* is met by the measures indicated in tuberculosis of the testicle.

CASTRATION.—The operation for the removal of the testicle is indicated when tumors, tuberculosis, gummata (occasionally), or extensive suppuration are present, and certain cases of undescended testicle.

Operation.—The testicle being made prominent, an incision is made from the base of the scrotum to the external ring. When the skin is involved, two elliptical incisions should be made. The testicle, with its tunics, is now quickly freed and the cord exposed. While traction is being made, a double catgut ligature is passed through the cord, with an aneurism-needle, the loop cut, and the needle withdrawn. The cord is then ligated in each half and once around, and divided one-fourth of an inch below the ligature. The stump is cauterized with pure carbolic acid to prevent infection of the wound from the vas. All hemorrhage being controlled the wound is closed by silkworm-gut sutures, the operator being careful to evert the skin-edges.

IMPLANTATION.—Recently, G. F. Lydston, of Chicago, found that successful total or partial implantation of human sex glands in both male and female was practicable,

Glands taken from the living subject are most desirable, though rarely obtainable. Glands taken from the healthy dead body at any time prior to the beginning of decomposition are of therapeutic value equal to that of those taken *in vivo* if implantation succeeds. In human beings the gland of one sex is transplantable upon the other and it is possible that the hormone of the one is useful to the other.

Report of 2 cases of bilateral testicle implantation, the one having been done in August, 1915, the other in October, 1916. In both patients there has been a return of the absent sexual functions, removal of most of the secondary female sex characters and acquisition of the secondary male characters, and other evidences of a permanent restoration of the testicular hormones. The writer holds therefore, that sex gland implantation is no longer purely experimental, but that it now stands on a firm therapeutic basis. Frank Lydston (Jour. Amer. Med. Assoc., March 30, 1918).

Lydston found that the tissues of the female are more hospitable to the implanted male sex glands than are the tissues of the male. The benefits of implantation probably accrue irrespective of the site of the implantation, but the vicinity of the peritoneum (extra-abdominal) in the female and of the tunica vaginalis in the male are the sites of election. The development of **senility** possibly can be retarded and longevity increased by internal sex secretion derived from implantation. The **climacteric** may be postponed by it, or the disagreeable features of the climacteric relieved. **Defective and aberrant psychical or physical sex development and differentiation—inversions and perversions**—are definite

indications for sex gland implantation. Certain cases of **cryptorchidism** and **imperfect testicular development** are an especially promising field for it. **Chronic diseases of the skin** due to or modified by nutritional disturbances—notably, certain types of **chronic eczema, psoriasis, and ichthyosis**—in a certain proportion of cases apparently are likely to be benefited and possibly cured by sex gland implantation. That **arteriosclerosis** will in its early stages be benefited by sex gland implantation is probable. Inferentially, if taken early, **senile dementia** possibly may show beneficial results. All conditions incidental to **sex gland mutilations** in either sex afford a positive indication for sex gland implantation, the probability of benefit being inversely as the length of time that has elapsed since the mutilation, and dependent on the age at which it occurred. The most important point of all is that in properly selected cases successful implantation ought inevitably to increase physiological efficiency with all the benefits accruing therefrom. With increased physiological efficiency come individual and social efficiency.

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PEPO.—Pepo, U. S. P., or pumpkin seed, is the dried ripe seed of *Cucurbita pepo*, family Cucurbitaceæ. The seeds contain a resin, an alkaloid (cucurbitine), oil, starch, sugar, etc. The oil is quite odorless and is of a mild, sweetish, pleasant taste. It has been claimed that the oil, in doses of ½ ounce (15 c.c.), possesses the medicinal effect of the seeds, but this claim has been denied. Before administration the seeds are crushed and beaten into a paste with milk and white sugar, and the resulting emulsion strained; or the seeds may be first decorticated and

the contents then rubbed up with milk or water and sugar. Pepo has a distinct diuretic action, but it is chiefly used as a very efficient and harmless tæniacide, in doses of 1 to 2 ounces (30 to 60 Gm.), prepared as before stated, taken on a fasting stomach, and followed in from one to two hours by an active purge. The resin (unofficial) has been given in doses of 15 grains (1 Gm.). The combination with oleoresin of aspidium (male fern) is effectual in destroying the **tape-worm**: oleoresin of aspidium, 1 dram (4 c.c.); chloroform, 10 minims (0.66 c.c.); emulsion of pumpkin seeds, 12 ounces (375 c.c.). To be divided into 2 doses, taken one hour apart, on fasting stomach, and followed by 1 ounce (30 c.c.) of castor oil an hour later. W.

PEPPER (Black Pepper).—Piper, U. S. P. (black pepper) is the unripe fruit of *Piper nigrum*, family Piperaceæ, a woody, evergreen, dioecious climber, obtaining support from living trees by means of a great number of small roots. It is a native of India and the neighboring islands. The berries are small, pungent and spicy to the taste, and of aromatic odor. They contain piperine or piperina (4.5 to 8 per cent.), a pungent resin, a volatile oil (2 per cent.), dipentine, philandrene, a peculiar terpene, and starch, but no tannin.

PREPARATIONS AND DOSES.—*Piper*, U. S. P. (black pepper). Dose, 5 to 20 grains (0.3 to 1.3 Gm.).

Oleoresina piperis, U. S. P. (oleoresin of pepper). Dose, $\frac{1}{4}$ to 1 grain (0.015 to 0.06 Gm.), best given in pill form.

Piperina, U. S. P. VIII (piperine). Dose, 3 to 6 grains (0.20 to 0.40 Gm.).

Confectio piperis, Br. P. (confection of pepper, 10 per cent.). Dose, $\frac{1}{2}$ to 1 dram (2 to 4 Gm.), several times daily.

PHYSIOLOGICAL ACTION.—Pepper is a powerful local and general stimulant. Its resin content imparts a burning taste and in large doses may cause distinct irritation of the mucosa of the mouth and throat. In large doses it may excite an inflammation of the gastrointestinal tract, and recorded cases show that this drug has produced delirium, rigors, and convulsions.

THERAPEUTIC USES.—Pepper has been used as a condiment and to **increase the secretion of the gastric and intestinal fluids** and to reduce **flatulence**. In **atony of the mucous membrane of the genito-urinary system** it is of decided value, but the presence of acute inflammation, as in gonorrhea, contraindicates its use. Piperine, formerly used in **malarial disorders**, is now employed with the cinchona alkaloids to increase their absorption and efficiency. Used externally, pepper, in the form of poultice or plasters, relieves **headache, colic, muscular rheumatism, and neuralgia**. The British confection of pepper, a substitute for "Ward's paste," is employed as a remedy for **anal fissure, hemorrhoids, and rectal ulcers**. W.

PEPPERMINT. See MENTHA.

PEPSIN.—Pepsin (pepsinum, U. S. P.) is a proteolytic ferment obtained from the glandular layer of fresh stomachs from healthy pigs, and capable of digesting not less than 3000 times its own weight of freshly coagulated and disintegrated egg albumin, when combined with 1000 times its weight of a 2 per cent. solution of hydrochloric acid and maintained for six hours at a temperature of not less than 100.4° F. (38° C.) or more than 104° F. (40° C.), the vessel in which it is contained being gently agitated every fifteen minutes. At the end of the given time little or no residue should be observed, but a few thin flakes of the coagulated albumin need hardly be regarded. Pepsin occurs in yellowish-white or white scales or in powder, having a slight acid or saline taste and should be free from odor. Much of the commercial pepsin is adulterated or contaminated with peptone, and may also contain mucus and albumin. The presence of peptone is manifested by its peculiar musty odor, and, if present in large amount, it will absorb moisture and become sticky when exposed to the air.

PREPARATIONS AND DOSES.—*Pepsinum*, U. S. P. (pepsin, 1:3000), 1 to 10 grains (0.06 to 0.65 Gm.).

Besides the officinal preparation, there are others on the market which may be preferred. *Essentia pepsini*, N. F. (1 to 4 drams—4 to 15 c.c.); *glyceritum pepsini*,

N. F. (45 minims—3 c.c.); liquor pepsini, N. F. (1 to 4 drams—4 to 15 c.c.); liquor pepsini aromaticus, N. F. (1 to 2 drams—4 to 8 c.c.), and vinum pepsini, N. F. (1 to 4 drams—4 to 15 c.c.) are available fluid preparations.

PHYSIOLOGICAL ACTION AND THERAPEUTICS.—The terms “peptonized” and “peptone” are so fixed in the popular mind in association with pepsin that many continue to regard a peptonized food as one made with or containing pepsin. Pepsin is not available for peptonizing food for the sick in the household. Its action is not only restricted to albuminous (proteid) substances, but, acid being indispensable, the product is, for this reason, unsuitable as a food. In the laboratory it may be used and is used, for there the acids are removed and the products are properly clarified. Pepsin is useless in the artificial digestion of milk. Pepsin cannot be used for the artificial digestion of food at the table in the way that pancreatic extract may be.

Hamburger asserts that fresh and inactivated animal serum, under proper conditions, will bind pepsin quantitatively in weak acid solution and will prevent it from digesting proteid, even after the addition of free hydrochloric acid in excess. This binding and inactivation of pepsin cannot be considered as due to a specific antipepsin. This phenomenon has been termed “pepsin deviation” in analogy with the deviation described for other ferments, notably trypsin. This ability of animal serums to deviate pepsin explains the published accounts of the so-called “anti-pepsin.” It has been found impossible, by the use of a technique elaborated to control pepsin deviation, to demonstrate normal antipepsin in the blood-serum of the dog, cat, guinea-pig, cow, horse, rabbit, and of man.

According to Aldor, pepsin, even in large quantities, has no inhibitory action on lactic acid or other fermentation, and whatever inhibition is exerted by native or artificial gastric juice depends on the hydrochloric acid.

In using pepsin, or other digestive ferment, certain points should be observed, lest the ferment become inert before ingestion. A digestive ferment should never

be mixed with water or any fluid of a higher temperature than can readily be borne by the mouth. In the peptonizing process, in sprays, in surgical solvents, too high temperature should be avoided. Pepsin is destroyed in alkaline solutions (with lime-water, sodium bicarbonate, aromatic spirit of ammonia, etc.). All ferments in solution soon decompose unless in the presence of an antiseptic. The ferments should not be mixed undiluted with strong, alcoholic tinctures or astringents. Pancreatic ferments should not be placed in acid mixtures. Pepsin and pancreatic ferments should not be mixed together in solutions, acid or alkaline. These mixed ferments cannot be permanently held in an active form in any solution. (Fairchild.)

Pepsin is best given with or immediately after food (as its digestive action is solely expended upon the proteids, which action takes place at once in the stomach), combined with hydrochloric acid (as the presence of the acid converts any pepsinogen in the gastric tubules into pepsin), as an aid to weak digestion. Pepsin is useful in **atonic dyspepsia**, especially in that present during **convalescence from acute diseases**. **Gastric irritability** is relieved by pepsin combined with bismuth in powder (bismuth in solution is incompatible with pepsin).

Pepsin is of value in **gastralgia**, **pyrosis**, **gastric catarrh**, and **infantile aepsia**. In **gastric ulcer** and in **carcinoma of the stomach** pepsin relieves the vomiting and assists the impaired digestive organs.

Pepsin is an efficient digestive ferment only in **proteid digestion**. It is useless in intestinal indigestion, as it has no solvent action upon fats or starches. As a remedy for **indigestion**, pepsin is much inferior to pancreatin (pancreatic extract) or papain.

In **infantile diarrhea** arising from indigestion pepsin is a useful adjunct to other treatment; essence of pepsin given in doses of 10 to 30 drops immediately after nursing will assist in the digestion of the milk-curds. In this disorder peptonized milk will give better results than pepsin.

In **typhoid fever** 5 grains (0.3 Gm.) of pepsin combined with 10 drops of dilute hydrochloric acid, given in a wineglassful

of water, after nourishment, three times daily, will be found useful in assisting the impaired digestive powers and in controlling the febrile movement.

Pepsin has been used as a surgical solvent. It is claimed that it will dissolve **blood-clots** in the **urinary bladder**, and render their expulsion easy. It has been used in **diphtheria** and **membranous croup** to dissolve the false membrane. For this purpose it may be applied in powder by insufflation, or in solution by spray or applicator (brush or probang).

Pepsin has been used as a local application to **cancers** and the unhealthy surfaces of **severe burns** and **sloughing ulcers**, with the view of removing sloughs and dead bone; and to **abscess cavities** and **sloughing wounds** to remove the dead tissue and bring about a clean, healthy condition. Glycerole of pepsin is best fitted for this use, although the dry powder or scales have been successfully employed for this purpose. W.

PERFORATING ULCER OF FOOT.—This is a condition in which an opening exists communicating with a sinus leading to diseased bone, and often surrounded with granulations.

SYMPTOMS.—The circumjacent skin is but slightly inflamed, but sometimes ulcerated. As a rule it is usually located over the metatarsophalangeal joint of the great or little toe, although other parts may be attacked either single or multiple; the affection may be located in one or both feet. A corn or callosity usually appears first and suppuration occurs underneath, and a sinus forms, opening in the center of the thickened epidermis. The sinus becomes deeper, and if unchecked reaches the bones and joints and disintegrates them. The discharge is usually slight and blood-stained, and the opening is found to lead down to diseased bone. Pain is frequently slight or absent, the insensibility of the diseased spot being generally marked; anesthesia is present over an irregular area, reaching at times nearly to the knees, the toes being especially without feeling. The local temperature is usually subnormal. During the primary stage of the disease sweating is very free. Distortion of the toes result from organic

changes which take place in the tendons. The nails are yellow in color and cracked and twisted to one side. The trophic changes are due to a thickening of the endoneurium, with compression and disintegration of the sensory nerve-fibers.

ETIOLOGY.—Perforating ulcer is usually caused by anesthesia of the sole of the foot, which allows repeated or long-continued irritation to pass unheeded. Contusion of the foot, through injury of a peripheral nerve, may give rise to the disease, or the nerve lesion may be of central traumatic origin. It is encountered in many diseases—*tabes dorsalis*, leprosy, the peripheral neuritis of alcohol, syphilis, and diabetes. More rarely it may be preceded by epithelioma, a neglected corn or callus, or some local injury. The pain may be marked in these cases. Hofmann, in 15 patients under his care, discovered only 1 case of organic nerve lesion, and attributed the disease to chronic alcoholism, in the form of wine drinking, combined with heavy manual labor.

PROGNOSIS.—Owing to the liability to recurrence of the affection from the persistence of the nerve lesions, even after healing, the prognosis is uncertain.

TREATMENT.—In the early stages relief of pressure, by confining the patient to a chair or by prolonged rest in bed or even the employment of an artificial limb fastened to the bended knee, will cause temporary healing, especially if the **thickened epidermis** is removed, after macerating it with a poultice, or by thoroughly soaking the foot in hot water, the sinus disinfected and drained, and stimulated by applications of weak solutions of silver nitrate or copper sulphate, or balsam of Peru.

Piccioli and Baroni have stretched the plantar and the tibialis nerves in these cases in connection with curettement and freshening of the ulcer, and the removal of necrotic material. They suggest that a more decided effect might be obtained by stretching the sciatic nerve under local anesthesia.

In advanced cases a Syme or Pirogoff amputation may be indicated; in exceptional cases amputation below the knee, beyond the area of anesthesia, will alone afford relief. W.

PERICARDITIS. See HEART AND PERICARDIUM, DISEASES OF THE.

PERICARDIUM, DISEASES OF. See HEART AND PERICARDIUM, DISEASES OF THE.

PERIHEPATITIS. See LIVER AND GALL-BLADDER, DISEASES OF THE.

PERINEUM, DISORDERS AND SURGERY OF. See PREGNANCY AND PARTURITION, DISORDERS OF.

PERIOSTITIS. See BONES, DISEASES OF.

PERIPHERAL NERVES. See NERVES, PERIPHERAL, DISEASES OF.

PERITONEUM, DISEASES OF THE.—There are two theories in regard to the development of the peritoneum. According to one, the cavity and its lining is a mesoblastic formation, and the endothelium is derived from the mesoblastic cells like that of the blood-vessels. On the other hand, certain anatomists hold that the peritoneal cavity is an offshoot of the original intestinal canal, formed of hypoblastic or epithelial cells. The epithelium becomes transformed into endothelium, and a connection with the lymphatic system develops later. This conception furnishes an explanation of the tendency on the part of the membrane to undergo carcinomatous change.

The great power of absorption of the peritoneum is both a menace and a defense. It is particularly active in the diaphragmatic layer and in the omentum, which latter attaches itself to any inflamed surface and acts as a barrier to the spread of microbic infection. By virtue of this absorptive power, invading microorganisms are carried off before they

can multiply *in situ*; while, on the other hand, the conditions for a general toxemia are, at the same time, rendered more favorable. In case of bacterial invasion, absorption is diminished by the inflammatory engorgement of the blood-vessels, by lymphatic engorgement, by the movements of the diaphragm, and by the limitation of peristalsis. A copious exudate in the peritoneal cavity may act favorably by diminishing absorption. The peritoneum differs in certain important respects from the other large serous membranes. It is much more sensitive to infection, and less resistant to the action of pathogenic organisms than the pleura and pericardium; but, while subject to almost every kind of infection, it appears to be immune to the microorganism causing the type of arthritis loosely designated rheumatism. Among the defensive equipment of the peritoneum may be mentioned also the phagocytic activity of the endothelial cells and of the leucocytes contained in the peritoneal fluid, and its bactericidal and antitoxic qualities. Anatomically a difference in the relations of the peritoneum in the male and female is to be noted, inasmuch as in the female the membrane communicates with the atmosphere through the Fallopian tubes (which furnishes an explanation of certain infections occurring in young girls). On the other hand, the pelvic peritoneum is thicker in women than in men.

Certain congenital bands and membranes, which have been studied and described in recent years, may manifest their morbid effects in the course of diseases of the intestinal tract, rather than of the peritoneum itself.

The most important of these are the so-called Lane's kink, a band of tissue at or a little above the ileocecal valve, and Jackson's membrane, consisting of web-like adhesions covering the cecum and ascending colon.

ASCITES.

The presence of free fluid in the peritoneal cavity has been treated from the surgical viewpoint in the first volume of this work (see ASCITES). The present section refers to the medical side of the subject.

When the accumulation is due to congestion it is spoken of as a transudate, or the term "hydroperitoneum" may be employed. In most cases of ascites, however, the process is in part inflammatory and in part the result of passive venous or lymphatic engorgement. The fluid is pale yellow or greenish in color, clear, of a specific gravity varying from 1.010 to 1.018, depending on the cause of the ascites, inflammatory exudates having a higher specific gravity and a greater protein content than fluid due to backward pressure. The reaction is alkaline. Blood-stained fluid occurs with malignant disease of the peritoneum, sometimes in cirrhosis, and in tuberculous peritonitis. The color may be yellow in jaundice. Chylous effusions may occur from leakage of chyle through the lymphatic vessels into the abdomen when there is obstruction in the course of the thoracic duct or lymphatic trunks. This form must be distinguished from fatty or chyloform ascites, or the formation of fat in a peritoneal effusion. The latter is usually associated with chronic peritonitis, either simple or tuberculous, or with intra-abdominal neoplasms. The cytology

of peritoneal effusions has some diagnostic importance: in transudates the endothelial elements predominate; tuberculous peritonitis is characterized by a high lymphocytosis; while in other forms of infection, polymorphonuclear leucocytes are chiefly found. When several causes are operative at the same time, as, for example, cirrhosis of the liver and tuberculosis, the characteristic cells of each affection may be present in equal numbers.

Ascites may be general or circumscribed, the latter form being more commonly due to disease of the peritoneum, although, in general, dropsy adhesions may at times limit the collection of fluid. It is under such conditions that differential diagnosis assumes the greatest importance.

SYMPTOMS.—The quantity of fluid varies from a pint or two to several gallons, and its presence is recognized by physical examination. Constipation, gastrointestinal disturbance, and interference with respiration, when the quantity is large, may suggest the presence of ascites, but the symptomatology is vague.

DIAGNOSIS.—Inspection discovers the globular shape of the abdomen, with sagging at the flanks in the recumbent, and bulging below the navel in the sitting posture; engorgement of the cutaneous veins (*caput medusæ*); distention of the skin and *lineæ albicantes*; prominence of the navel, and restriction of respiratory movements. The apex beat of the heart is displaced upward. Fluctuation or thrill is elicited by gently tapping one side of the abdomen with the fingertips and feeling the "thrill," or impingement of the waves of ascitic fluid on the palm of the other hand

in contact with the opposite side. This sign can be elicited only when the abdomen is so distended with fluid that the diagnosis can practically be made at a glance, and is therefore of little value in doubtful cases. *Percussion* is the most reliable method of examination in all doubtful cases. Areas of dullness are discovered in the flanks in the dorsal posture, increasing in extent on one side or the other as the patient is brought into the lateral position. The tendency of distended coils of intestine to float up against the abdominal wall sometimes obscures the findings and must be remembered. By careful percussion, noting the changes in the limits of dullness in the various postures—dorsal, lateral, and sitting,—even small quantities of fluid in the peritoneal cavity can be detected by careful percussion.

Conditions which must be differentiated from ascites are chiefly ovarian cyst, a distended bladder, pregnancy, and large abdominal tumors. Mistaking an *ovarian cyst* for ascites will be avoided by remembering that, whereas in the latter the intestines float up against the anterior abdominal wall, causing a tympanitic note in the umbilical region, an ovarian cyst, like any other large abdominal tumor, displaces the intestines and comes in direct contact with the anterior abdominal wall. Hence dullness at and about the umbilicus in ovarian cyst, instead of tympany, and absence of bulging and dullness in the flanks. Rarely an abnormally short mesentery holds the intestines down, and there is dullness at the umbilicus in ascites; again, ovarian cyst and ascites may be present at the same time. The tumor of

pregnancy and a *distended bladder* can readily be differentiated from an effusion if the conditions are thought of and ordinary care is exercised in examination. In the presence of ascites *chronic peritonitis* may be overlooked if, as is often the case, the general symptoms are mild. A history of cardiac, hepatic, or renal disease, the symmetrical character of the enlargement, the absence of pain and fever, and the absence of tumor masses after the fluid has been drawn off, will aid in avoiding this error.

The nature of the fluid varies with the cause of the ascites and is of diagnostic value. In *simple dropsical effusions* the fluid is clear and serous, occasionally slightly tinged with blood in old cases of *cirrhosis*. Hemorrhagic fluid, when obtained at the first tapping, is suggestive of *cancer or sarcoma*; it is also found in *tuberculous peritonitis* and in *multiple serositis*. After *rupture of a viscus, an aneurism, or the sac of an ectopic pregnancy* the fluid obtained is deep red, or consists almost entirely of fresh and shed blood (hemoperitoneum). Chylous fluid is sometimes obtained after an *excessive milk diet*, and occurs in cases of *Filaria sanguinis hominis* from disease of the lymphatic vessels. Ascites associated with a tumor points to *malignancy*.

ETIOLOGY.—The causes of ascites are in the main obstructive, as in heart disease and cirrhosis of the liver, and toxic; *i.e.*, due to the action of a toxin on the endothelial cells of the peritoneum, as in acute and subacute infections. Since, however, several causes may be, and very frequently are, operative at the same time, etiological classification is impracticable for clinical purposes, and

a simple enumeration of the conditions in which ascites occurs, in the order of their importance, will be found more satisfactory:—

1. Cirrhosis of the Liver (Portal, or Laennec's Cirrhosis).—The ascites is mechanical, due to increased pressure in the portal vein, and in part also to the action of toxins on the peritoneal endothelium. Quite often cirrhosis is complicated by cardiac disease, more rarely by tuberculosis, which are then responsible for the ascites. In such cases the fluid accumulates early in the course of the affection, and numerous tapplings may be required. Ascites occurs in about 80 per cent. of cases of portal cirrhosis. In the biliary form (Hanot's cirrhosis) ascites occurs, if at all, at a late stage and is not a conspicuous feature; it is probably brought about by the development of portal as well as biliary cirrhosis.

(See also CIRRHOSIS OF LIVER, volume iii, p. 410.)

2. Cardiac Failure.—Ascites due to heart-failure is seen in its most typical form in tricuspid regurgitation complicating mitral disease, usually stenosis, and in advanced cases of myocarditis without valvular lesions. It is less frequent with aortic disease. As a rule, there is at the same time edema of the lower extremities and of the scrotum (absent in cirrhotic ascites), which is accordingly regarded as an important point in the differential diagnosis between cardiac and hepatic ascites. But it may happen that the backward pressure in a case of heart-failure affects the hepatic veins chiefly or exclusively, so that there is ascites without general edema,—a condition spoken of as "hepatic asystole," and

closely resembling ordinary cirrhosis. Adherent pericardium is an occasional cause of passive effusion into the peritoneal cavity.

3. Chronic Peritonitis.—Under this head are included a number of conditions: simple diffuse or localized peritonitis; the form associated with malignant disease, and local peritonitis due to ovarian or uterine neoplasms, whether benign or malignant, in which large and frequently recurring accumulations of fluid in the peritoneal cavity are sometimes observed.

4. Bright's Disease.—The ascites is ascribed to the action of the nephritic toxin, as observed in the acute exacerbations of chronic parenchymatous nephritis, when it occurs early and as part of general anasarca. It may, however, be the result of cardiac dilatation and failure of compensation secondary to hypertrophy, as observed in the terminal stages of either parenchymatous or interstitial nephritis. It is probable that in every case of ascites occurring in the course of Bright's disease the cardiac factor predominates in the etiology. In early and in acute cases, edema is more marked in the extremities and in the tissues of the face, while ascites is quite frequently absent.

5. Diseases of the Liver other than Cirrhosis.—Perihepatitis, simple or syphilitic, and other syphilitic lesions of the liver, which may or may not be associated with chronic peritonitis. Ascites usually accompanies malignant tumors of the liver (carcinoma, sarcoma, echinococcus cyst). The neoplasm may press upon and obstruct the branches of the portal vein, or, projecting from the surface of the organ, set up a peritonitis with

effusion. Ascites results from obstruction of the portal vein by thrombosis, tumors of adjacent parts, or peritoneal adhesions.

6. Obstruction of the Inferior Vena Cava.—The causes are thrombosis, mediastinal tumors or adhesions, and the presence of *Filaria sanguinis hominis*.

7. Anemias.—Ascites is usually present to a moderate degree in leukemia with splenic enlargement. It is less frequent in secondary and in pernicious anemia, although it may occur in these and other diseases of the blood, and in malarial anemia with splenic enlargement.

The following systematic classification from Anders and Boston, "Text-book of Medical Diagnosis," 1914 edition, page 565, has the merit of being comprehensive:—

(a) Diseases of the Peritoneum:—

Tuberculous peritonitis.
Carcinomatous peritonitis.
Non-suppurative acute peritonitis.
Peritoneal adhesions.
"Simple" chronic peritonitis.
Hydatid cysts in the peritoneal cavity.

(b) Obstruction to the Main Portal Vein:—

Non-suppurative thrombosis.
Peritoneal adhesions.
Aneurism.

(c) Tumors and Enlargements of Adjacent Organs:—

Liver.	Duodenum.
Pancreas.	Colon.
Kidney.	Suprarenal capsule.
Stomach.	Retroperitoneal sarcoma.

(d) Hepatic Causes:—

Atrophic cirrhosis.	Carcinoma.
Hypertrophic cirrhosis.	Sarcoma.
Perihepatitis.	Cyanotic liver with enlargement.
Syphilis.	Pulsating liver (chronic).
Hydatid disease.	

Any condition accompanied by extensive enlargement of the liver may, from

obstruction by torsion of or pressure on the portal vein, be accompanied by ascites.

(e) Obstruction of the Inferior Vena Cava:—

Thrombosis.	Chronic adhesive pleurisy.
Obstruction of thoracic duct.	Congenital cysts.
Rupture of thoracic duct.	Filariasis.
Rupture of the receptaculum chyli (chylous ascites).	Stenosis by chronic mediastinal adhesions.
	Occlusion by mediastinal growth.

(f) Chronic Valvular Heart Conditions usually accompanied by:—

Tricuspid regurgitation.	Aortic stenosis.
Mitral stenosis.	Aortic regurgitation.
Mitral regurgitation.	Adherent pericardium.
Myocarditis.	Fibroid heart.
Fatty degeneration.	Primary alcoholic heart.
Fatty infiltration.	
Fatty superposition.	

(g) Nephritis:—

In Bright's disease ascites may be caused in different ways:—

Part of a general dropsy.
Secondary to hypertrophy and dilatation of the heart, followed by failure of compensation and tricuspid regurgitation.

(h) Essential Anemias:—

Splenomedullary leukemia.	Aplastic anemia.
Lymphatic leukemia.	Splenic anemia.
Hodgkin's disease (rare).	Pernicious anemia.

TREATMENT.—The treatment of ascites, aside from the indications furnished by the basal disease, consists in **removal of the fluid by absorption or paracentesis**. Absorption is stimulated through **catharsis and diuresis**. **Mercurials**, as **calomel** or **blue mass**, followed by **saline purgatives**, **compound jalap powder**, and **elaterium** still maintain their popularity in cirrhotic cases. In cardiac ascites, **infusion of digitalis** in large doses, besides **free purgation**, should always be tried, especially in relatively

early cases. **Diuretics** are likely to prove disappointing until after paracentesis has been performed, when they may assist in preventing or at least retarding reaccumulation of fluid in cardiac cases. It is advised that **fluids be restricted** in the diet, but the effect on absorption is usually slight.

Whenever the effusion is so great as to cause the patient distress by its mechanical pressure, and particularly in cases of cirrhosis of the liver, **paracentesis** should be performed without delay. The procedure is comparatively simple and painless and, with the most ordinary care, entirely free from danger. The operation may have to be repeated a number of times at varying intervals in cirrhotic cases, and instances are reported in which, due probably to the formation of adhesions as a result of the repeated tapplings, the accumulation of fluid ultimately ceased and the patient survived for some time, free from the most distressing effect of his malady.

Technique of Paracentesis Abdominis.—The patient sits on the edge of a chair or, if too feeble, is propped up in bed in a sitting posture, and a roller bandage is applied snugly to the upper part of the abdomen, covering the umbilicus. The skin below the level of the umbilicus is cleansed in the usual manner with soap and water, alcohol or ether, or both, and painted with tincture of iodine. The puncture should be made in the median line, midway between symphysis and umbilicus, or on either side, midway between symphysis and anterior superior spine. A preliminary incision, half an inch in length, through the skin and subcutaneous fat, will minimize the pain of the pro-

cedure, especially in obese subjects. No local anesthetic is necessary. Before inserting the trocar, the operator must make sure, by percussion, that there is no loop of intestine in the way. A straight trocar, one-eighth of an inch (0.32 cm.) in diameter, is suitable, and the stylet usually has to be reinserted from time to time during the flow, to free the lumen of fragments of lymph. As the fluid is withdrawn, the abdominal bandage is tightened from time to time, in order to maintain a constant pressure on the abdominal contents and prevent collapse. Daily injections of **adrenalin chloride**—1 dram (4 Gm.) in 1 ounce (30 c.c.) of water—into the abdominal cavity, are recommended after paracentesis, to prevent or retard reaccumulation.

Talma devised an **operation** for the cure of ascites in cases of cirrhosis of the liver. The abdomen is opened and the peritoneum irritated by forcible rubbing with gauze, so as to set up a moderate degree of inflammation. The object of the procedure is to produce artificial peritoneal adhesions and thus promote collateral venous circulation between the general and the portal systems and relieve the pressure in the portal vein. Cures are obtained in about 37 per cent. of cases so treated, according to Talma, but the mortality of the operation is high.

Case of advanced ascites from cirrhosis of the liver which had persisted six months. The writer treated the patient with subcutaneous injections every other day of 10 c.c. (2½ drams) of his own **ascitic fluid**. On the third day there was a marked increase in the urinary output and a beginning absorption of the fluid which continued until the eleventh day, when

injections had to be stopped for want of fluid. Vitry and Sézary (*Revue de méd.*, Feb., 1913).

ACUTE GENERAL PERITONITIS.

So-called general or diffuse peritonitis rarely involves the entire peritoneum. The term implies that the inflammation is not strictly localized and that the constitutional symptoms are severe. In practice two forms, **acute diffuse or general**, and **acute localized or circumscribed** peritonitis are distinguished.

SYMPTOMS.—While the symptomatology is largely determined by the primary cause, there is a well-characterized clinical picture of acute peritonitis which has been handed down to us by the early Greek writers. In an ordinary case of rapidly spreading perforative peritonitis the onset is sudden, with intense pain at the site of the infected focus, rapidly becoming general. The abdomen, at first rigid and retracted, becomes distended, tender, and painful; the pulse and temperature curves rise together; the character of the pulse is small, hard and "thready," while the blood-pressure may be high. The degree of pyrexia is variable. There is a characteristic expression on the patient's countenance: the pinched and drawn features, the skin covered with cold sweat, and the look of anxiety in the hollow eyes make up the well-known picture of the Hippocratic facies. The breathing is shallow, of the costal type, due to pain-inhibition; the tongue is dry, and there is constant thirst. The bowels are constipated, as peristaltic paralysis is a marked and early feature; the urine scanty, high-colored, albuminous. To ease the severity of the pain,

which is greatly increased by movement, the legs are flexed at the knees and drawn up on the belly. As the abdominal distention increases, vomiting sets in, fluid begins to collect in the peritoneal cavity, and the general signs of severe toxemia appear in face and attitude; the pulse weakens and becomes more rapid, sometimes attaining 160 or 170 beats in the minute; the skin is cold and clammy, although the temperature continues to rise; cyanosis develops, and the extremities become cold. Death results from heart-failure, pulmonary edema, or aspiration of fluid into the lungs. The mind usually remains clear until near the end.

Relation of localized tenderness to perforative peritonitis: The site of the perforated ulcer, as indicated by moderate abdominal palpation within several hours after the onset, is not uniformly intensely sensitive. Neither is it always the most sensitive area. In addition to the well-recognized local symptoms referable to the region of the perforated ulcer and the appendix, other parts of the abdominal viscera may, exceptionally, be the seat of confusing sensitiveness. Stratton (*Calif. State Jour. of Med.*, July, 1914).

Variations from this classical picture, of course, occur and are best described in connection with the individual causal conditions, typhoid perforation, appendicitis, and the like.

Pain is a constant symptom except rarely in the presence of typhoid perforation,—in which condition the entire absence of pain has, in the writer's experience (in negroes), caused failure of timely diagnosis, though the patient's mind was clear,—and in greatly exhausted or stuporous patients. It is constant, progressive, intolerable, aggravated by all move-

ments even of the diaphragm, and inhibits the respiratory movements of the abdomen. The distribution is general and shows no constant relation to the seat of the lesion.

Tympanites usually develops in from twenty-four to forty-eight hours. Liver dullness is obliterated; the percussion note is high-pitched over the vault of the abdomen, fading into dullness at the flanks when the fluid has accumulated. Absence of gurgling on account of intestinal paralysis is a significant symptom.

Vomiting is due to the same cause and is fairly constant unless there is diarrhea; it may at last become fecal even in the absence of obstruction. Hiccough is a distressing symptom, usually occurring late and obstinately refractory to treatment.

The respiration, as stated, is of the costal type, shallow and hurried, 40 to 50 per minute, and accompanied by cyanotic discoloration of the tip of the nose, ears, and extremities.

The pulse is accelerated, regular, at first 100 to 120 per minute; at last becoming more and more rapid and impossible to count. It is small, wiry or thready, and the tension is high—160 to 170 mm.—until near the end, when the blood-pressure falls.

The temperature is variable, with a general tendency to hyperpyrexia, but exhibiting no constant relation to the severity of the toxemia. Even the sudden fall in temperature which precedes the onset of peritonitis from typhoid perforation is not a constant phenomenon. In general, the temperature is of little diagnostic value.

There is a moderate reduction of the erythrocytes, said to be due to concentration of the blood. Leuco-

cytosis of the polymorphonuclear type is the rule, but cannot be depended upon. In severe cases the leucocytes are not increased, and there may even be leucopenia. Blood-cultures may show the causal organism, but are usually sterile.

The urine is scanty and high-colored, and usually contains a small quantity of albumin, diacetic acid and acetone, and indican. Retention of urine is sometimes present.

The following special forms of acute peritonitis require separate mention:—

Puerperal Peritonitis.—Puerperal peritonitis is due, in the majority of cases, either to *Streptococcus pyogenes* or to *Gonococcus*, the former type being by far the more virulent. The colon bacillus, in this variety of the disease, is less important as a causative agent. The infection enters through solutions in the continuity of the genital tract, after labor or a criminal abortion; and extension, which is exceedingly rapid, takes place through the lymphatics. The infection progresses rapidly, and early leads to a grave toxemia. Meteorism is marked, being increased by the relaxed condition of the abdominal walls following labor. Diarrhea and vomiting are commonly present. An early clinical sign is a change in the odor of the lochial discharges. The tendency of puerperal peritonitis is to general septicemia and a fatal issue. Complications are phlebothrombosis and arthritis.

Pneumococcal Peritonitis.—The disease is rare and occurs more often in children than in adults. It is not, as a rule, secondary to pneumonia, but pneumococcal lesions may be present elsewhere than in the peri-

toneum. Thus, there may be an accompanying pneumonia or bronchopneumonia, empyema, otitis media, or pericarditis due to a pneumococcal infection. Rarely the infection reaches the peritoneal cavity from a pleurisy, through the lymphatics of the diaphragm. Usually the disease is "primary," *i.e.*, the peritonitis is the chief or only focus of infection, which is believed to have been conveyed through the blood- or lymph- channels (from a focus in the thorax or in the throat or ear), through the intestines (appendicitis), or through the Fallopian tubes. Both a diffuse and an encysted form are described. The pus resembles that of an empyema—fibrinous, greenish yellow, and odorless. A **pneumococcal polyorrhomenitis** involving pleuræ and pericardium as well as the peritoneum has been described in young children.

The histories of 9 cases showed 2 clinical types of pneumococcic peritonitis: (1) that clearly secondary to a pneumonia or empyema, and (2) that apparently primary or idiopathic. The onset of the first may be unattended by any definite symptoms. The onset of the second group is characterized by symptoms so acute as to immediately overwhelm the patient. P. W. Beaven (*Amer. Jour. Dis. Children*, Oct., 1920).

The onset is acute, with vomiting and pain referred to the lower abdomen, simulating appendicitis, for which the condition is often mistaken in the early stage. Diarrhea sets in, and the signs of peritonitis develop.

The symptoms are relatively mild, resembling those of tuberculous peritonitis rather than of the more acute forms. A prolonged stage usually follows, with the formation of adhesions resulting in an encysted peritonitis. The abscess or abscesses may

discharge spontaneously through the bowel or vagina. Rarely the temperature falls by crisis. The prognosis is fairly good in encapsulated cases that are **opened and drained**.

The sudden onset, often with a chill, is followed by an extremely high temperature with a high leucocyte count. Diarrhea is a conspicuous symptom and peritonitis with diarrhea always suggests the pneumococcus. There is lack of localizing symptoms, as compared with the perforative type of peritonitis, and the abdomen is described as having a "doughy" feel. There is marked toxemia and the patient seems far more ill than the abdominal symptoms would indicate. Bacteremia is generally present and blood cultures should always be made. Syms (*Annals of Surgery*, lxxvii, 263, 1918).

Gonococcal Peritonitis.—A mild form occurring almost exclusively in women; very rarely the peritoneum may become infected in male patients through the lymphatics of the spermatic cord. The course is usually short and sharp, abating in two or three days. The exudate is fibrinous and contains only a little pus or serum. There is no distention or rigidity of the abdomen. The *diagnosis* is based on the pain in the lower abdomen and the presence of a gonorrheal discharge. Operation is not indicated, and the prognosis is good except in young children.

Peritonitis in Infants.—The symptoms of peritonitis in children are more obscure than in adults; and the condition is, therefore, more frequently overlooked in its early stage. The sudden onset, with vomiting, fever, distention and tympany of the abdomen, rapid pulse and hurried respiration, is not characteristic of any especial type of infection. The

acute form is usually fatal within a few days. The causes of peritonitis in infants are intestinal obstruction, volvulus, intussusception, strangulation of the intestines due to any cause (such as congenital atresia or adhesions), and occasionally appendicitis. Peritonitis may develop secondarily from an empyema. A septic type of peritonitis occurs in newborn infants, the infection being derived from the mother through the umbilical cord. The causal micro-organism in these cases is usually a streptococcus. Recovery is rare. It is believed that peritonitis in fetal life is the cause of congenital malformations, atresia of the intestines, imperforate anus, etc.

Case of purulent peritonitis in an infant 21 days old. The infection was probably umbilical. In a second case the infant was nearly 5 months old and the peritonitis was evidently secondary to enterocolitis. A third infant only 3 weeks old was taken suddenly, and necropsy showed stenosis in the small intestine as the only probable cause. All the children were breast fed, but the first showed signs of inherited syphilis. Hydrocele is frequent in such cases, with edema of the scrotum, as an early sign of the peritonitis. Acuña and Casaubon *Prensa Med. Argent.*, Sept. 10, 1918).

Occasionally the process may become localized, with the formation of adhesions and abscesses. Unless this is the case, surgery in general streptococcic peritonitis is useless.

DIAGNOSIS.—Peritonitis may be simulated by *colic* due to flatulence and constipation, lead poisoning, gall-stones or renal calculus. There is, however, no real tenderness and the abdominal pain is relieved by pressure. Vomiting is rare except with the passing of calculi. When

fever is present from the beginning of the attack, peritonitis should be suspected.

In adhesive peritonitis visceral adhesions resulting from attacks of peritonitis are frequent, but they cannot be diagnosticated clinically. They are detected, however, by means of X-rays. Den (*Roussky Vrach*, Feb. 18, 1912).

Hysteria, giving rise to the phenomena of "peritonism," can be excluded by the usual means. There is usually a history of hysteria and possibly of similar previous attacks. Examination shows cutaneous hyperesthesia, but no real pain, and the symptoms may be made to disappear by distracting the patient's attention.

The relation between peritonitis and *mechanical obstruction of the bowels* must be kept in mind in making a diagnosis. Obstruction is followed in a few days by peritonitis and, on the other hand, peritonitis leads to obstinate constipation which practically amounts to obstruction by paralyzing peristalsis. In obstruction there is absolute stoppage of both feces and flatus; in peritonitis an enema is usually followed by the passage of wind. There is less tendency to fever in obstruction, and the pulse is of good volume and not markedly accelerated; peristalsis persists or is even increased; pain is colicky, not continuous, and there are less tenderness and rigidity; fecal vomiting occurs early; finally, there is no evidence of fluid in the abdomen or of inflammation in the various organs.

From *acute hemorrhagic pancreatitis* the diagnosis may be extremely difficult. The points to be remembered are the great severity of the symp-

toms from the onset, the board-like hardness of the abdominal wall in the epigastric region, and the extreme prostration. The pulse is very feeble from the outset and the temperature not very high. Fat-necrosis is found on opening the abdomen.

Diffuse retroperitoneal inflammation has never received an adequate description, although cases are not infrequently met with. When it complicates inflammation in the upper abdomen (most often pancreatitis and biliary and hepatic disease) the diagnosis may be made with a fair degree of certainty. There is fullness of the abdomen in its upper half, the lower abdomen being free. The fullness is chiefly in the lateral regions, and does not shift on changing the position of the patient. These symptoms may be present, however, in retroperitoneal inflammation in the lower abdomen.

The symptoms which may aid in differentiating retroperitoneal from intraperitoneal inflammation are: the generalized deep tenderness and absent superficial tenderness and pain, absence of peritoneal symptoms with the rapid development of deep-seated symptoms in the first few days. Secondary peritonitis often develops soon after retroperitonitis, in many instances, so that the picture is often obscure. Sprengel (Archiv f. klin. Chir., Bd. ci, Heft 2, 1913).

Rupture of an ectopic gestation sac, and certain grave and rare accidents in the abdominal cavity, such as *rupture of an aneurism, embolism of the superior mesenteric artery, and hemorrhage into the mesentery, twisting of the pedicle of an ovarian cyst*, should be remembered in the differential diagnosis. When any of these conditions is suspected and the diagnosis is not clear, the abdomen should be opened.

In peritonitis from rupture of a pyosalpinx the first symptoms are in-

sidious; first a little pain in the abdomen, then vomiting follows, the temperature rises and the pulse increases, the abdomen is soft but tender. The diagnosis is generally merely peritonitis from perforation. In 47 of the 78 cases prompt laparotomy saved 27 of the patients; the best results were always obtained when the ruptured tube was removed. The patients all died in the 31 cases in which no operation was attempted. Lamouroux (Arch. gén. de chir., Jan., 1910).

Rupture of pyosalpinx as a cause of acute diffuse purulent peritonitis. Study of 91 reported cases and 1 personal case of diffuse purulent peritonitis from rupture of the pus-tube. In many of these cases there is a history of *repeated attacks of pain* for a week or so before the attack that marks the rupture. These attacks the writer considers of great diagnostic importance, "for in a case of pyosalpinx they suggest impending rupture and the need of operation, and in a case of acute purulent peritonitis of unknown origin they suggest the possibility of a ruptured pus-tube." W. M. Brickner (Surg., Gynec., and Obstet., May, 1912).

The danger of mistaking a thoracic for an abdominal condition at the beginning of the attack has been pointed out by most systematic writers on diagnosis, but should be emphasized once more in this connection. In children, especially, a *pleurisy* or a *lobar pneumonia* may be missed at first when pain in the abdomen is the only symptom complained of. A study of the temperature, pulse, respiration ratio, and careful, repeated physical examination of the chest will always suffice to guard against this error, providing the possibility of pneumonia is in the examiner's mind. In any doubtful case operation should be postponed, as the appearance of characteristic physical signs is often

delayed, especially in cases of central pneumonia.

Plea for early recognition of peritonitis as a complication of typhoidal ulceration, in order to reduce mortality from perforation. The latter is often only the chance termination of an inflammatory condition which should have been recognized long before. Muscular rigidity is the only constant early sign of peritonitis in typhoid. Patient to be examined in warm room, in horizontal posture with knees drawn up. The presence of rigidity is determined by a succession of short, delicate "pushes" with finger-tips, finger-joints being kept flexed. Hawkes (*Annals of Surg.*, May, 1911).

PATHOLOGY. — Acute Circumscribed Peritonitis.—This form is seen most frequently in the pelvis and in the appendiceal region. The peritoneal vessels at first are injected, and the membrane loses its normal luster with the loss of endothelial cells. The exudate, at first serous, soon becomes fibrinous and then fibropurulent as the abscess localizes. The organisms most commonly found are *Bacillus coli communis* and *Staphylococci*. The process ends in spontaneous external or internal rupture; inspissation of the pus, caseation or even calcification, or in absorption and the formation of dense adhesions.

Peritonitis seems to be most commonly associated bacteriologically with a combination of the *Bacillus coli* and other organisms, usually staphylococci and streptococci. The origin clinically is usually endogenous, the affections of the appendix being of major importance, the female organs of generation being next in importance. Exogenous peritonitis is becoming exceedingly rare with the improvement of aseptic technique in the handling of wounds and in operative methods. M. Fishbein (*Amer. Jour. Med. Sci.*, Oct., 1912).

Acute General Peritonitis.—This may result directly from perforation of an infected viscus, or may be secondary to the localized form when the abscess ruptures. The so-called primary or hematogenous form has been described under ETIOLOGY. The initial changes are the same as in the circumscribed variety. The character of the exudate varies with the type and severity of the case. There may be an abundant serous outpouring, a veritable acute inflammatory ascites, in severe, toxic cases; or the exudate may be small in quantity, collected in pockets formed by the dense adhesions which characterize the fibrinoplastic cases, the intestines and omentum being matted together in a dense mass. The exudate consists of yellow pus from the action of pyogenic bacteria, or it may be brownish gray, putrescent in severe cases with secondary necrotic changes, as in strangulation of the intestine with gangrene, or in severe puerperal sepsis. The fluid is often hemorrhagic, particularly in the presence of passive congestion. In rapidly fatal cases very little pathological change may be noted.

ETIOLOGY.—Theoretically aseptic peritonitis, due to chemical irritants or bacterial toxins, exists; but for practical purposes all cases of peritonitis may be regarded as caused by bacterial infection. The term "primary peritonitis" is still employed to designate inflammation of the peritoneum without demonstrable localized focus in an abdominal viscus. Peritonitis is said to be "hematogenous" when it occurs in the course of a general infection without discoverable cause other than supposed infection through the blood- or lymph-

paths. The source of infection in such cases cannot be discovered. True primary inflammation of the peritoneum is unknown. These forms are diffuse from the beginning, in contradistinction to those in which a general peritonitis results from the breaking down of adhesions surrounding a primarily localized focus. The most frequent bacterial causes are: *Bacillus coli communis*, *Staphylococcus albus* and *aureus*, *Streptococcus*, and sometimes *Pneumococcus*, in peritonitis resulting from perforation of an abdominal viscus, appendix, stomach, or small intestine. Puerperal peritonitis is usually due to *Streptococcus*. Occasional causes are: *Pneumococcus* ("hematogenous peritonitis"); *Gonococcus* (localized genital type in females); *Bacillus of Friedländer*; *Bacillus pyocyaneus*; *Bacillus capsulatus aërogenes*, and, rarely, *Bacillus tuberculosis*, and possibly *Bacillus typhosus* (Chantemesse's typhoid peritonitis).

Infection may occur (a) from without—trauma, operation; (b) by continuity through perforation of an infected hollow viscus (the most frequent mode of infection), or rupture of an abscess in or around a solid organ, such as a perinephric abscess; (c) by continuity without solution of continuity through the wall of hollow, tubular structures—intestines, Fallopian tubes; (d) by way of the blood- and lymph-channels, as in so-called "primary," "hematogenous" peritonitis in the course of general infections (pneumonia, erysipelas, typhoid fever), puerperal sepsis, pneumococcal peritonitis, cancer, late nephritis, and the like. It must be remembered that the source of infection may be difficult

to find, and the term "cryptogenetic infection" in such cases becomes appropriate. The most frequent bacterial causes are *Bacillus coli communis* and the pyogenic germs.

[Wilson gives the following enumeration of morbid conditions in the course of which acute general peritonitis may arise (J. C. Wilson, Jour. Amer. Med. Assoc., July 9, 1898). The list does not include traumatism and gynecological lesions: (1) Alimentary tract: gastric and duodenal ulcer, appendicitis, enteric fever. (2) Gall-bladder, pelvis of kidney, urinary bladder. (3) Empyema, subphrenic abscess, liver abscess, abscess of pancreas. (4) Necrotic processes: internal strangulation, intussusception, volvulus, embolism and thrombosis of mesenteric vessels, gangrene of pancreas or spleen, acute hemorrhagic pancreatitis, fat-necrosis].

PROGNOSIS.—The mortality of acute general peritonitis is high, and the prognosis is more grave in children and aged subjects than in the young and middle-aged. A persistently low temperature; very rapid, thready pulse; distention of the abdomen, and absence of leucocytosis are bad prognostic signs. Perforative peritonitis almost always ends fatally unless operation is possible, and the abdomen is opened within twelve hours of the onset of symptoms. The most virulent organisms are *Streptococcus pyogenes* and *Bacillus pyocyaneus*; next in inverse order of severity are *Bacillus coli communis*, *Pneumococcus*, *Gonococcus*, and *Staphylococcus albus*. Traumatic perforation (bullet and stab wounds) gives a better prognosis than perforation due to disease (typhoid ulcer, appendicitis). The higher the perforation in the alimentary tract, the better the prognosis, because in both cases colon bacilli are less numerous and of lower virulence.

Study of the factors influencing mortality of peritonitis in 63 recent cases of appendicitis, complicated by local or diffuse peritonitis, with the following result: Not purged before admission, 7; recovered, 7; died, 0. Opiates before admission, 22; recovered, 18; died, 4. No opiates before admission, 41; recovered, 38; died, 3. Pfeiffer (Penna. Med. Jour., xix, 604, 1916).

TREATMENT.—Acute General Peritonitis.—Aside from the strict observance of **aseptic precautions** in all surgical procedures in the abdominal cavity, certain special procedures are employed by surgeons to limit the risk of infecting the peritoneal cavity. **Preliminary injection** into the peritoneal cavity, twelve hours before operation, of **horse serum or nuclein** to induce leucocytosis, is recommended; or the **injection of salt solution or adrenalin**, before or after operation in the hope of preventing absorption through the lymphatics, may be tried. The utility of these measures still remains to be determined.

To prevent or inhibit peritonitis the following are recommended: 1. **Gastric lavage** immediately, where nausea, or gaseous distention (except where peritonitis follows perforation of stomach or duodenum). 2. **Rectal instillation of normal saline** by drop method, continuing for one to two hours, then interrupting for two hours. Where this method not practicable, give 500 to 1000 c.c. (1 to 2 pints) of **saline solution subcutaneously**, repeating as required to relieve thirst and keep vessels filled. 3. **Fowler position**. 4. **Large, hot, moist dressing of saturated boric acid solution and alcohol** in equal parts applied to abdomen. 5. Give **no cathartics or food by mouth**; even **prohibit water** till patient on way to recovery. **Feed by enemata** consisting of 1 ounce (30 c.c.) of concentrated liquid

food in 3 ounces (90 c.c.) of normal saline; add 10 to 50 drops of **deodorized tincture of opium** to each feeding till no longer painful. Administer slowly every three or four hours through rubber catheter introduced not more than three inches. A. J. Ochsner (Boston Med. and Surg. Jour., Feb. 10, 1910).

The use of 1 per cent. **camphorated oil** in acute peritoneal infections shows marked results. It seems to prevent lymphatic absorption of bacteria and toxins and prevents the formation of adhesions, lubricating the loops of intestine so they do not adhere together. Minor benefits are its action on heart and its antiseptic properties. The writers have had considerable experience with it, injecting 200 to 300 c.c. ($6\frac{2}{3}$ to 10 ounces) in adults, and found it absolutely harmless. Vignard and Arnaud (Revue de chir., May, 1912).

In threatening cases, thorough rinsing out of the abdominal cavity with 25 or 30 quarts (liters) of physiological **salt solution** at 40° C. (104° F.) under general anesthesia recommended. This is done rapidly, the pelvis lowered to the utmost, rinsing out all the recesses and crevices and sopping up with sponges all the superfluous fluid. Then 30 c.c. (1 ounce) of tepid 10 per cent. **camphorated oil** are poured in and distributed with swabs. In 200 cases in which these measures were applied, no injurious consequences could be discovered, while the outcome was very satisfactory. Weber (Münch. med. Woch., Aug. 12, 1913).

The writer prevents post-operative peritonitis in the following way: After incising he allows a certain quantity of **camphorated oil** to flow into the abdomen, then places the patient in the operating position, and, after covering the ventral opening, allows a dozen or so inspirations, protective compresses being placed to absorb the excess of oily fluid. Camphorated oil tends to prevent obstruction of the lymphatic channels, checks agglutination of bowel loops,

allows prolonged drainage and plays an important rôle as heart tonic. Three hundred cubic centimeters of 1 to 100 strength can readily be injected. This procedure yielded good results. Chaton (*Presse méd.*, p. 395, 1916).

Surgical Treatment.—This offers practically the only hope of saving the patient's life. Operation must be performed early, within twelve, or, at the latest, twenty-four hours of the perforation.

The peritoneum has acquired the power of overcoming infection by immobilizing the point infected by (a) inhibiting of the intestines; (b) distention of the intestines; (c) rigid persistent contraction of the abdominal muscles; (d) further fixation by the pouring out of a sticky, glue-like fluid. In peritonitis, as in physical exertion of any kind, the transformation of energy utilized for this purpose might be so rapid and extensive that exhaustion—death even—might follow. This exhaustion was further increased by the loss of water due to vomiting and to the diminished intake. If energy transformation is minimized by **morphine** given in large physiological doses, and if the water equilibrium was maintained by the **instillation of water**, the point of infection is immobilized, while the phagocytes overcome the infection, and at the same time the brain, suprarenals, and liver are protected and the energy of the patient is conserved. G. W. Crile (*N. Y. Med. Jour.*, Oct 31, 1914).

The objects of operation are: (1) to **remove the cause of infection**—the inflammatory focus, **close or excise a ruptured or ulcerated viscus** (typhoid ulcer, intestinal obstruction), and (2), in cases of non-perforative peritonitis, to **open and drain localized abscesses**. The manipulations must be performed rapidly and with a minimum of traumatism to the abdominal contents.

Certain auxiliary measures are important, among which may be mentioned, first of all, the so-called **Ochsner conservative treatment**, consisting in **posture**, the application of **cold to the abdomen**, and **enteroclysis**. The patient is placed in bed, in a modified sitting posture known as **Fowler's position**, and enteroclysis is administered two or three times in the twenty-four hours, or the salt solution may be given by the Murphy drop by drop method. If the saline mixture is not absorbed by the bowel, or if a more intensive action is desired, it may be administered by the hypodermic route or, in emergency cases, intravenously. The temperature of the water should be somewhat above body heat, and only small quantities should be introduced into the circulatory system at a time—not more than 10 ounces (300 c.c.). The introduction of this amount should occupy about twenty minutes. Equally good results are obtained with a moderate as with a large quantity of salt solution, with a minimum of danger to the cardiovascular system.

In the 500 cases of diffuse or general peritonitis reported by the writer there were 9 deaths. This includes the deaths in the hands of several assistants. In 124 of these cases the incision was in the median line for a general peritonitis with distention. In the remaining cases with a diffuse peritonitis, the toilet was always proportionate to the extent of involvement of the peritoneum. Three of the deaths were in patients over 70. One of the patients died one hour after the operation. This patient went on the table with a subnormal temperature of 96 degrees. Another patient lost was a vigorous man with cecum and appendix on the left side. The appendix was gangren-

ous and retrocecal. The error in this case was that the incision was made on the right side. Kennedy (Surg., Gynec., and Obstet., March, 1910).

Review of 609 cases of progressive free peritonitis. All measures are dominated by these requirements: **Early and rapid operation; stopping of leakage; peritoneal drainage aided by posture; maintenance of the patient's strength by enteroclysis; withholding of food and drink while vomiting persists;** and finally the discreet administration of **opiates**. The average mortality in 461 cases of free progressive peritonitis of appendicular origin treated from 1899 to 1908 was 31 per cent.—the percentage diminishing steadily from 79 in 1899 to 14 in 1908. The mortality among 148 cases due to injuries and affections of other viscera was 100 per cent. in tumors; 76.5 per cent. in intestinal perforations; 87.5 per cent. in complicated hernias; 66.6 per cent. in disease of female genitalia; 73.9 per cent. in typhoid perforations; 46.1 per cent. in gastric and duodenal ulcers; 66.6 per cent. in perforation of liver abscess; 100 per cent. in thrombosis of mesenteric vessels. Gerster (Annals of Surg., April, 1910).

Critical cases of peritonitis that develop after abdominal operation demand **early operative interference** before the condition becomes hopeless. In patients presenting serious symptoms the writer does not hesitate to **reopen the abdomen** and **wash out the cavity** and institute **drainage**. This procedure has considerably lessened his mortality in such cases. H. Robb (Cleveland Med. Jour., Oct., 1911).

Review of personal experience in 194 cases of acute septic peritonitis due to appendicitis. In 188 cases operation was performed. In 83 cases in which treatment consisted in giving fluids by the mouth, saline enemas every three or four hours with the Fowler position, 60 patients recovered (72.3 per cent.) and 23 died (27.7 per cent.). In 39 patients treated by the elevated head and trunk position, and fluids administered by the mouth

only, 30 recovered (76.9 per cent.) and 9 died. Combining these 2 series, we have 112 cases in which the **Fowler position** was maintained and **fluids given by the mouth**, the recovery percentage being 72. In 58 cases in which the so-called ideal treatment was used, *i.e.*, the **Fowler position, Murphy proctoclysis** and **nothing by the mouth**, 39 patients recovered and 19 died, a mortality per cent. of 34.5. R. S. Fowler (Jour. Amer. Med. Assoc., Nov. 4, 1911).

The writer recommends that **grape-sugar** be added to the fluid used for **irrigation** in peritonitis so as to make a physiological concentration: sodium chloride, 0.9 Gm. (14 grains); grape-sugar, 4.1 Gm. (62 grains); water, 100 Gm. (3½ ounces). **Sugar solutions** are the most potent means of counteracting the inflammatory condition. In the peritoneal cavity it aids drainage, interferes with the formation of secondary abscesses, and helps to preserve the peritoneum itself. Hemolytic and toxic products the direct result of peritoneal inflammation are found to a much smaller extent in the presence of sugar solution. There is comparatively little indication for the employment of sugar solutions in early peritonitis (first forty-eight hours). It is in the later cases and in cases in which abscesses have formed that the solutions are useful. F. Kuhn (Archiv f. klin. Chir., Bd. xcvi, Heft 3, 4, 1911).

The writer treated 2 cases (1, peritonitis following ruptured gastric ulcer; 2, peritonitis following intestinal perforation) in which **ether washing**, first described by Morestin, was of marked benefit. After cleansing away as much of the pus, fibrin and intestinal contents as possible, a large quantity of **ether** (150 to 400 c.c.—5 to 13½ ounces) are poured into the abdomen and quickly mopped up. After **drainage** the abdomen is closed. This method is especially useful in perforation peritonitis arising from appendicitis, ruptured pyosalpinx, etc. F. Derganc (Wiener klin. Woch., Aug. 14, 1913).

Ether tried in 16 cases. The writers poured ether into the peritoneum in the treatment of peritonitis from appendicitis in children. The impression on the whole is quite favorable. The sedative action of the ether was noticeable and welcome after the operation when child patients are usually more or less agitated. There was less tendency to vomit and the children seemed drowsy and quiet. With circumscribed inflammation they used from 30 to 80 c.c. (1 to 2 $\frac{2}{3}$ ounces) of ether, pouring it into the pus-cavity after its evacuation. When the peritonitis was diffuse, they poured 200 c.c. (6 $\frac{2}{3}$ ounces) of ether into the peritoneal cavity. The **cavity** was always amply **drained**. In 3 of the 16 cases there were complications on the part of the lungs, fatal in 2 cases. Is it possible, they ask, that the ether could have affected the lungs? Phélip and Tartois (*Annales de gynéc. et d'obstét.*, Dec., 1913).

It is strongly advised that suspected cases of acute appendicitis be placed and maintained in the **Fowler position**. Early institution of postural drainage is of greater benefit to the patient in preventing septic material from reaching the diaphragmatic peritoneum than in preventing further absorption after this area is once involved. Ambulance cases of appendicitis should be brought to the hospital in the sitting posture. The trunk should be elevated during the operation. The cart which transfers the patient to and from the bed should be elevated at the head. The manner of instituting postural drainage matters but little, provided that the pelvis is sufficiently low for gravitation to take place, and the patient is comfortable. It has been shown (Buxton) that there is a rush of bacteria toward the diaphragmatic lymphatics of the peritoneum as soon as infection comes in contact with it.

Postural drainage to be effectual, therefore, must be maintained all the time.

Ochsner's treatment should be instituted before and after operation

and **Murphy's proctoclysis** should be practised. R. H. Fowler (*Amer. Jour. of Surg.*, May, 1913).

The writer advocates the free use of **opium** recommended by Alonzo Clark many years ago, on the plea that the common cause of death in peritonitis, as in any acute infection, is exhaustion due to the expenditure of energy in combating the infection; the toxic effects of the acid by-products; the reduced intake of food; and the insufficient sleep resulting from severe pain.

The dose should be measured by its effect upon the respiratory rate and not in grains.

Laboratory findings show that opium affords intestinal rest, and protects the brain, adrenals, and liver against the damaging effects of toxin. With **nitrous oxide** and **local anesthesia combined**, proper **drainage**, the **Fowler position**, and physiological rest of the intestines, the chances of a good result are greatly increased. Crile (*Editorial, Therapeutic Gazette*, Sept., 1916).

When **Dakin solution** is brought in proper contact with an infected surface it will destroy pus; if this does not happen, it is because there is some focus not reached by the solution or because of imperfect technique.

Its use causes a rapid return of strength, and the post-operative course is more comfortable and with less danger of secondary complications. Any offensive discharge is destroyed almost immediately.

It is contraindicated in the presence of an intestinal fistula. That it may delay the final healing by interfering with the normal granulating process in some instances, may be true. Further observation is necessary to determine this question. Huggins (*American Journal of Obstetrics*, lxxviii, 423, 1918).

The question of **postoperative irrigation** is an important one. Most surgeons advise against it, on the ground that it adds to the risk of fur-

ther spreading of the infection and interferes with the action of the phagocytosis and with the absorptive power of the lymphatics in the peritoneal cavity. It should be reserved for special cases.

Intramuscular injections of quinine were found to effectively prevent peritoneal infection, and led to their use after appendectomies and operations for pelvic disease with suppuration. A watery solution of **quinine bisulphate**, 1 to 11, was employed in amount of 3 c.c. (45 minims), injected into the muscles of the thigh. The injections were made three or four times daily, sometimes being continued until the fifth day after operation. J. Kaczyinsky (Archiv f. klin. Chir., Bd. xciii, Heft 4, 1911).

Medical Treatment.—The medical treatment of peritonitis has practically been covered in the foregoing paragraph, and may be summarized as purely expectant. The patient is placed in the **Fowler position** to encourage drainage—or, rather, to counteract, if possible, the extension of the infection toward the diaphragm. During the acute stage, **no food, nor even fluid**, should be given by the mouth. **Purgatives are absolutely contraindicated.** Thirst is relieved by **enteroclysis**; and what **nourishment** is to be given must also be administered by way of the **rectum**. Severe vomiting may be controlled by **lavage**. Tympanites is an indication for a **turpentine stupe** and a **medicated or oil enema**. The introduction of the **rectal tube** alone is sometimes followed by the escape of flatus and the relief of the symptom. **Opium is absolutely contraindicated**, so long as the **diagnosis remains in doubt**; and, even after the latter is established, it should be given only to relieve ex-

treme pain, as it adds to the danger of intestinal paralysis. The pain should be controlled by local applications, especially the **ice-bag** in adults. If the patient goes into collapse, however, **external warmth** is required. Crile has recommended the intravenous administration of a **1:50,000 adrenalin solution with atropin**, and has reported occasional successes from its use. The procedure is, however, not free from danger, as sudden death has occurred from pulmonary edema as the result of it.

In infants the *treatment* consists in administration of **castor oil** and, after the intestinal tract has been cleared, the symptomatic use of an opiate (**paregoric**), to control the pain. Children do not bear cold applications to the abdomen, but react better to the **application of heat**. The child's strength should be maintained by **careful feeding** with **brandy** and **concentrated prepared foods**, such as **liquid peptonoids, peptomangan**, etc.

Flushing the abdominal cavity with a constant stream of **oxygen** which escapes through drains at the lowest points found efficient by the writer in a case of diffuse peritonitis in a woman of 30. Besides the biological stimulating effect of the oxygen, the gas helps, the writer asserts, to expel all morbid products and fluids. From the previously almost dry drains poured a flood of serous and purulent fluid after the jet of oxygen was turned into the abdomen. Having no tank, he had to apply the oxygen from rubber bags, a bag containing 20 liters (quarts) taking about half an hour to empty itself. The oxygen acted more effectively when it was introduced through the different drains in turn. Banzet (Presse méd., Feb. 1, 1911).

Camphorated oil is excellent in peritonitis. It may be injected either

subcutaneously or intraperitoneally. For subcutaneous injection, large amounts are necessary, that is, from 30 to 40 c.c. (1 to 1½ ounces) of a 10 per cent. solution in twenty-four hours. For intraperitoneal injections a 1 per cent. preparation is used in such a way that, after operation for peritonitis and before the abdomen is closed, from 200 to 300 c.c. (6⅔ to 10 ounces) of sterile camphorated oil is deposited in the abdominal cavity. This may also be introduced through the drainage-tube after the abdominal wall is closed. F. Jacoulet (Paris méd., March 23, 1912).

The writer has been much impressed with the advantages of application of **superheated air to the abdomen** after a laparotomy. He applies it three hours after the operation, the temperature not over 80° to 90° C. (176° to 194° F.), and only for half an hour, repeating this three times a day during the first days after the operation. The dressing is turned back and only the lowest layers of gauze left over the wound. He has applied this to 108 patients and has not had a death from perforation since he has made a practice of it. The patients say that the hot air is soothing and reduces the pain; it also starts peristalsis, and for this reason he used it also in 43 hernia cases. Momberg (Deut. med. Woch., March 20, 1913).

Analysis of 902 operative cases of diffuse peritonitis during the last twenty years. The mortality varied according to the cause, but it averaged 63.3 per cent. The writer never witnessed any benefit from pouring oil, with or without camphor, into the abdominal cavity, but was quite encouraged by the stimulating action of 500 c.c. (1 pint) of a 5 per cent. **solution of grape-sugar**, which was poured into the abdominal cavity and allowed to drain away. A hypertonic **salt solution** answers the same purpose; both induce copious secretion in the abdominal cavity and thus cause an autoflushing of the peritoneum, as it were, while it renders

the pus more fluid. Oil, on the other hand, seemed to favor adhesions and mischief generally. J. Grekow (Beiträge z. klin. Chir., Feb., 1914).

The Serum Treatment.—This is still in the experimental stage. Polyvalent sera, to neutralize both *Bacillus coli* and *Streptococcus* infections, are available, but the results obtained with them have not been very satisfactory so far. Antistreptococcic serum has been used extensively in puerperal septicemia—without, however, any marked success.

Injections of **horse serum** were administered by the author in 34 cases of incipient or developed peritonitis, some of the postoperative type and others arising from various causes. In adult patients 40 c.c. (1½ ounces) of sterile serum were injected intramuscularly; in children, 20 c.c. (⅔ ounce). Although in a few cases the injections had no noticeable effect, in many there was strikingly rapid subsidence of the peritoneal disturbance. T. Hirano (Deut. Zeit. für Chir., Sept., 1913).

ACUTE CIRCUMSCRIBED PERITONITIS.—Acute non-suppurative circumscribed peritonitis occurs over organs the seat of inflammation, such as the appendix, the intestines, the female genital organs, the gall-bladder, and the liver, resulting in a localized inflammation of the peritoneum. Occasionally a splenitis or hepatitis may result from spreading of an inflammation of the pleura or pericardium through the diaphragm. The chief and, practically, the only *symptom* of the condition is localized pain of varying severity, usually increased by pressure. Rarely a friction rub may be heard over the spleen or liver. The occasional *effects* of localized peritonitis are more important, and consist in the formation of

local adhesions. Local peritonitis is, in fact, a method by which nature may prevent a general infection of the peritoneal cavity, by walling off an abscess, a perforating ulcer, or other common source of peritonitis. These adhesions, again, may themselves become the cause of disturbances of a mechanical nature,—internal herniæ, obstructions in the neighborhood of the pylorus, adhesive bands in various parts of the abdomen and pelvis, particularly in women. The consideration of these disorders is best taken up in connection with the organs or regions where they are located.

The *treatment* of acute non-suppurative peritonitis is symptomatic; that is, the relief of pain, chiefly by **external hot or cold applications**, according to the patient's personal predilections. Opiates are rarely required.

Suppurative Circumscribed Peritonitis.—Under this general title are included abscesses in relation with various organs and regions of the abdomen, such as perigastric abscess, pericolic abscess, retroperitoneal abscess, and subphrenic abscess. A retroperitoneal abscess may result from a variety of causes, such as disease of the lung resulting from tuberculous, psoas, or iliac abscess; disease of the kidneys, such as calculus or tuberculosis; or traumatism resulting in a perinephric abscess; infected retroperitoneal glands; occasionally perforations of viscera, either traumatic or ulcerative. The local signs are often very obscure, or even entirely absent, and the *diagnosis*, therefore, except in the well-defined types, such as psoas abscess or abscess of the kidney, practically impos-

sible. The general symptoms of sepsis (pain, fever, rigors, and leucocytosis) are usually present; but suggest a general infection, rather than a local focus.

The *treatment*, when the diagnosis can be made, is purely surgical.

In treating patients with local peritonitis, following a septic puerperium, simple **drainage** through Douglas's pouch should always be adopted when the local area of infection is within reach. Any attempt at radical removal of a pyosalpinx or an infected ovary is certain to be followed by a severe general septic condition which may be quickly fatal. Hicks (Jour. of Obstet. and Gynec. of Brit. Empire, May, 1913).

SUBPHRENIC ABSCESS.

Subphrenic abscess occurs secondary to infection in some other organ, not necessarily contiguous to the diaphragm. Among the common causes may be mentioned appendicitis. The abscess is usually on the right side. The complication is serious, and is not so very uncommon. Among 86 fatal cases of acute appendicitis, a subphrenic abscess was found in 7, or 8.13 per cent. (Christian and Lehr.)

Abscess of the liver, or suppurating hydatid cyst, represents another occasional cause of subphrenic abscess. Abscess of the spleen is rare. Perforation of a gastric or a duodenal ulcer may give rise to a gaseous subphrenic abscess, if the perforation has been sufficiently large. Occasionally a subphrenic abscess results from disease of the pancreas, gall-bladder, or kidney; and it may even arise from tuberculous disease of the spine. Nevertheless, subphrenic abscesses due to these causes are rare. Finally, the source of infection in

cases of subphrenic abscess may be undiscoverable.

As the appendix and the liver are the most common sources of infection, it follows that simple subphrenic abscess is more common on the right than on the left side. The abscess may be intraperitoneal or extraperitoneal, but is usually the former. Elsberg collected 73 cases of subphrenic abscess due to appendicitis, and found that the abscess was intraperitoneal in 35, or 48 per cent.; in 20, or 27 per cent., it was extraperitoneal; and in 18, or 25 per cent., the relation to the peritoneum was not determined.

The boundaries of a subphrenic abscess, which are determined by the organs and structures with which it is in contact, may be still further modified by the presence of adhesions, and are, therefore, subject to great variations. The adjacent pleura usually becomes affected, with a resulting effusion, which may remain serous and sterile, or may likewise become purulent. The abscess may actually perforate the diaphragm and discharge its contents into the pleura, producing an empyema; or into the pulmonary tissue, producing multiple abscesses or gangrene. It is interesting to note that the pyopneumothorax in cases of subphrenic abscess is not necessarily due to a communication with the lung or with any hollow viscus, the gas being the result of bacterial activity. Occasionally the abscess may rupture externally or into the stomach or colon; but this is rare. Rupture into the peritoneal cavity is always to be feared, and is usually fatal.

SYMPTOMS.—As the development of subphrenic abscess is usually

gradual, the symptoms are difficult to distinguish from those of the primary disease. The general symptoms of infection—fever, diarrhea, rapid pulse, etc.—persist; and it is only after a time that the physical signs at the base of one or the other lung suggest the complication that has developed. This may occur, however, in cases of abscess due to appendicitis; and thoracic manifestations may precede the usual signs of appendicitis. When the abscess is on the right side, the symptoms are those of hepatic, or possibly pancreatic, disease. Rarely, as after perforation of a gastric ulcer, the onset is sudden, with pains and the signs of pneumothorax.

Unless the abscess is opened, the tendency is toward progressive loss of strength, and death eventually results from exhaustion, after a duration that may be as much as two or three months. Spontaneous rupture into the pleura, lung, bronchus, peritoneum or one of the abdominal viscera is rare.

DIAGNOSIS.—The *physical signs* vary according as the abscess is simple (does not contain gas) or gaseous. More commonly the physical signs produced by a subphrenic abscess are found posteriorly over the base of one or the other lung. There is dullness, which slowly spreads upward toward the scapula, with the signs of compression of the lung above the area of dullness. Along with these phenomena, the signs of pleurisy, with or without effusion, may be present. In the main, the signs of subphrenic abscess are simply those of a pleural effusion. Litten's diaphragm phenomenon may be useful in enabling one to decide, in a

doubtful case, whether the effusion is above or below the diaphragm. This, however, may be done with still greater certainty by means of the X-ray, which not only indicates the position of the effusion, but also—by means of a fluoroscopic examination—shows the limitations in the excursion of the diaphragm. In those cases in which the abscess is more anterior, the signs are more prominent in the abdomen. They consist in tenderness and a fullness below the costal margin, and possibly a palpable tumor, which is dull on percussion. This may, however, be modified by the interpolation of a coil of intestine between the abscess cavity and the abdominal wall—a point to which attention has been called by Godlee. Occasionally redness and edema of the skin (inflammatory edema) may be present; and if the abscess is very superficial, fluctuation may even be elicited. The symptoms and secondary signs of sepsis—sweating, irregular temperature, leucocytosis, and anemia—may be present. Clubbing of the fingers is said never to occur with a subphrenic abscess, but only with lesions above the diaphragm.

After any of the conditions that are known as possible causes of subphrenic abscess, particularly after disease of the appendix or gall-bladder, or any lesion in the neighborhood of the diaphragm, a systematic examination of the base of the lungs, not omitting an X-ray study, should be made whenever the patient fails to recover within the expected time and the signs of suppuration persist. If an abscess is suspected, the diagnosis may be confirmed by means of the exploratory needle. The needle should, however, be large enough to

permit the passage of thick pus. The tenth, ninth, eighth, seventh, and sixth interspaces, in the scapular line, are explored in turn; and if no pus is found, the same spaces in the mid-axillary line should also be explored before the attempt is abandoned. The patient should be fully anesthetized during the procedure. On the other hand, exploration through the abdominal wall is not advised. The differentiation of subphrenic abscess from *empyema* offers the greatest difficulty, which, however, can usually be overcome with the aid of the X-rays, as has been stated. It is always to be remembered that fluid may be present both above and below the diaphragm. If this condition is suspected, it may be confirmed by the difference in the character of the fluid obtained by exploratory puncture through different interspaces. "Febringer's sign" may be of value in determining the position of a collection of fluid. If the aspirating needle is above the diaphragm, no movement of the needle will occur. On the other hand, if the needle passes through the diaphragm, the needle will move upward on inspiration and downward on expiration. Another sign that is characteristic is that suggested by Pfuhl: when the needle enters a subphrenic abscess the pressure and outflow are greater during inspiration and less during expiration, the reverse being the case in *empyema*.

When the subphrenic abscess contains gas, the term "subphrenic pyopneumothorax" is employed. The commonest cause of such an abscess is perforation of a gastric ulcer, particularly if the perforation occurs on the posterior surface of the organ, a

similar accident on the anterior surface being more likely to result in general peritonitis. The perforation of a duodenal ulcer is also an occasional cause.

Certain differences in the *symptomatology* are observed when the abscess contains gas. The onset is usually sudden and the pain severe, the symptoms being, in fact, due to the perforation of a hollow organ, which produces the abscess. The pain is usually accompanied by vomiting. The vomitus contains blood and bile. The abdomen rapidly becomes extremely tender and, as a rule, distended; although it may be rigidly contracted and immovable on respiration.

The *physical signs* are those of pneumothorax, with certain differences, due to the anatomy of the condition. On the right side, the diaphragm may be greatly displaced upward—sometimes as high as the second rib; while on the left side the same degree of displacement is prevented by the presence of the heart. The same variation of dullness and tympany with a change in the patient's position is observed as in pyopneumothorax. Metallic tinkling, amphoric breathing and the succussion splash may be heard, as in the former condition. In left-sided subphrenic abscess, the heart will be displaced upward; but laterally the displacement will be very much less than in pneumothorax of the same relative severity. In right-sided cases the liver is displaced downward, and may be palpable at the level of the umbilicus, the hepatic dullness being, of course, absent from its normal position.

In the diagnosis between *pyopneu-*

mothorax and a gaseous subphrenic abscess, certain points may be of value. The apex of the heart, if displaced, is displaced upward, but very little to the opposite side. The physical signs of pneumothorax are confined to the lower part of the lung, leaving the upper portion comparatively normal. The characteristic signs of pneumothorax may be obtained farther down than the normal limits of the thoracic cavity. Cough and expectoration are not prominent symptoms. Finally, the X-ray will assist in clearing up the diagnosis, by locating the position of the diaphragm. The possible association of subphrenic pyopneumothorax with a *pleural effusion* must also be borne in mind. This condition may be detected by the same methods as have been discussed in connection with non-gaseous abscesses.

PROGNOSIS.—The prognosis of subphrenic abscess is always grave, and is rendered still more so when the abscess contains gas.

TREATMENT.—The treatment is entirely surgical.

SIMPLE CHRONIC PERITONITIS.

While the common classification into circumscribed and diffuse is usually maintained in textbooks, a chronic peritonitis is, as a matter of fact, rarely general or equally distributed over the entire peritoneum. The distinction between simple diffuse peritonitis and tuberculous peritonitis, or that which accompanies malignant disease is always difficult. Indeed, it may almost be said that a chronic peritonitis is called simple when both tuberculosis and neoplasm can be excluded from the etiology.

The terms proliferative, indurative, exudative peritonitis, which are frequently employed, explain themselves. Ascites is usually a prominent feature of the condition. When, as is frequently the case, the peritonitis is associated with chronic inflammation of the pleura and pericardium, with the production of exudates in these cavities, the term "polyserositis," "polyorrhomenitis," or "Concato's disease" is frequently employed. The extent to which the different serous membranes are involved and the order of their involvement are both subject to considerable variations. The condition is characterized, in a general way, by thickening of the membranes, the extent of which depends on the duration of the process. It may even go to calcification. Dense adhesions of the two layers of the pericardium (adherent pericardium), or between the pericardium and the covering of the liver are associated with the presence of effusion. The various types of polyorrhomenitis have been classified according to the point of origin of the inflammation—whether above or below the diaphragm. Thus, pericarditis may be the primary lesion, and may be followed later by perihepatitis and peritonitis; or the reverse may be the case. The process is, as a rule, most marked over the liver and spleen. In the former it gives rise to the condition which Curschmann has called "*Zuckergussleber*" (icing-liver), and which we usually designate simply chronic perihepatitis. On the other hand, Pick describes a condition that he calls "pericardial pseudocirrhosis," which, he believes, originates in adherent pericardium, gives rise to secondary circulatory disturbances in

the liver and produces thickening of the capsule, ascites, and the signs of cirrhosis generally. Simple chronic peritonitis is also found in association with arteriosclerosis and chronic Bright's disease, which are regarded by a number of authorities as the principal causes of the condition.

SYMPTOMATOLOGY.—While the disease is most common in middle age, it will be remembered that a number of cases of polyserositis have been described as occurring in children. The principal clinical manifestation is chronic ascites, tending to recur after removal by tapping. The number of tapplings required in a single case may be enormous, and eventually a cure—or, at least, an arrest of the ascites—may be obtained. Occasionally the ascites is encysted, causing irregular enlargements of the abdomen and complicating the diagnosis. The symptoms and signs of chronic disease of the heart and kidneys are frequently present. The urine is scanty, and middle-aged patients usually show the signs of chronic interstitial nephritis. Jaundice is not usually present. The course is insidious, and the disease usually manifests itself first by discomfort and rumbling in the abdomen, due to the accumulation of the fluid. Constipation and some degree of dyspepsia are usually present. Edema of the feet, developing after the ascites has been present for some time, is a rather constant finding.

PROGNOSIS.—This is generally unfavorable; but some cases, as has been stated, achieve a relative recovery after numerous tapplings. The duration varies, according to Nicholls, between two and sixteen years. Death usually occurs from some

intercurrent infection, such as pneumonia, or is due to cardiac failure.

ETIOLOGY.—This is not very clear. It has been explained either by infection with organisms of low virulence which are able to exert their influence on account of the diminished bactericidal power of the blood that is said to be a resultant of chronic renal disease; or, by the action of the uremic poison present in the blood of patients with arteriosclerosis and chronic nephritis, directly producing the inflammatory changes in the serous membranes. Alcohol, lead, and other poisons are believed to play a secondary part in the etiology, by reducing the resistance of the peritoneum. Finally, a simple chronic peritonitis may develop in connection with some inflammatory abdominal lesion, which in ordinary circumstances would be followed by local peritonitis and abscess. Such lesions are chronic cholecystitis or duodenal ulcer and syphilitic disease of the liver. Some authorities still believe that chronic peritonitis is always tuberculous. Other bacteria that have been suggested as the cause are *Bacillus coli* and *Bacillus typhosus*. It is certain, at least, that tubercle bacilli are not infrequently found in cases with ascites that do not present the usual signs of tuberculous peritonitis.

TREATMENT.—The treatment is necessarily palliative and symptomatic, with such **measures** as can be instituted **to combat the cause**, if it can be determined,—whether heart disease, nephritis, syphilis, or any other morbid condition. The Talma-Morison operation, which has been suggested, fails to give relief. The **fluid** must, of course, be **removed**

whenever it accumulates in sufficient quantity to produce discomfort; and the **tappings** must often be repeated at short intervals. The injection of **adrenalin chloride**, 1 dram (4 Gm.) in an ounce (30 c.c.) of water, which has been recommended in cases of ordinary cirrhosis, may also be tried. Laparotomy is not indicated.

TUBERCULOUS PERITONITIS.

This term, as generally used, includes, besides the inflammatory change in the membrane itself: tuberculous ulceration of the intestine; tuberculous infection of the glands in the peritoneal cavity; and, in female subjects, tuberculosis of the female genitalia, particularly the Fallopian tubes. An acute form of tuberculous peritonitis has been described, beginning usually, in the appendiceal region, and clinically not to be distinguished from appendicitis. The infection probably reaches the peritoneum through the lymphatics, from primary foci that may be located in various parts of the body,—the lungs, intestines, lymphatic glands, pleuræ, prostate, testicles, etc. In the majority of cases, according to Nothnagel, the lungs are primarily affected, and tuberculous peritonitis develops without the presence of intestinal ulceration. The latter, indeed, quite frequently occurs secondarily to pulmonary tuberculosis without implication of the peritoneum. In women, tuberculosis of the Fallopian tubes is a very common source of tuberculous peritonitis. The bacillus of bovine tuberculosis is believed to be a prolific if not the most common cause, though a certain proportion of the cases, at least, are probably due to

the human tubercle bacillus swallowed with the sputum.

From the clinical as well as the pathological standpoint, a certain classification is desirable, although the various forms necessarily overlap. Such classifications have been suggested by a number of writers, and may be summarized as follows:—

1. An *ascitic*, exudative, serous, or miliary form, characterized by an abundant effusion and miliary tubercles disseminated over the peritoneum.

2. A *nodular*, ulcerative, or perforative form, called “chronic tuberculosis” by Osler, in which there is a tendency to the formation of larger growths, which ultimately ulcerate or become caseous; the fluid in these cases being partly purulent, the term “suppurative” is sometimes employed.

3. A *fibroplastic*, adhesive, or obliterative form, or “chronic fibroid tuberculosis,” with little or no exudation and massive adhesions.

The first, or ascitic form, is more acute in its course, and may be associated with miliary tuberculosis. There are few if any adhesions, and the exudate is free in the peritoneal cavity (not encysted). The miliary tubercles are found over the intestines, mesentery, omentum, and diaphragm, as well as on the peritoneum itself.

In the second or nodular form, the lesions are much larger and somewhat pigmented, and there is thickening of the peritoneum and omentum, causing a resemblance to malignant disease. Adhesions form between the intestines and the spinal column. These adhesions give rise to the formation of pockets, which may contain serous or purulent exudate. The

mesenteric glands are enlarged and caseous, and sometimes converted into an abscess.

The third or fibroplastic type is characterized by universal adhesions, causing a matting together of the abdominal viscera and their attachment to the abdominal wall. Clinically this gives rise to tumor-like masses, which may be felt through the abdominal wall. This obliterative form may be the end-result of the ascitic type of tuberculous peritonitis, or it may develop independently.

Finally, it is to be observed that tuberculous peritonitis may be associated with cirrhosis of the liver, the latter being apparently the earlier process. Involvement of the peritoneum in simple chronic peritonitis or polyserositis has been discussed.

SYMPTOMATOLOGY.—This is vague. There is moderate fever, with general loss of strength and flesh, and indefinite pain and discomfort in various parts of the abdomen. In women there is often pelvic pain. In the ascitic form there is gradual enlargement of the abdomen with, finally, the appearance of the definite signs of ascites. A certain relation between the clinical symptoms and the pathological types described has been established. In the ascitic or miliary form abdominal distress and the signs of effusion are prominent. In the fibroplastic form the symptoms characteristic of the presence of adhesions, kinks, bands, painful tumors, etc., are in evidence, and emaciation and cachexia are apt to be more pronounced. As the disease is so frequently secondary to pulmonary tuberculosis, the characteristic signs should always be looked for in the lungs. Moderate diarrhea is common, and this symp-

tom is exaggerated when there is extensive intestinal ulceration, which, as has been stated, may be regarded as belonging to the picture of tuberculous peritonitis. Perforation of a tuberculous ulcer, although rare, sometimes occurs. In a case seen by the author, which occurred only a few days after the patient's admission to the hospital, the diagnosis between tuberculous peritonitis and typhoid fever had not been definitely determined before the autopsy, which revealed extensive tuberculous ulceration. In this case the symptoms and course during the two days the patient was under observation closely simulated those of a grave case of typhoid fever previous to perforation. The disease may be latent for some time, and may be revealed by the sudden onset of an acute peritonitis, due to some accident, such as the rupture of a caseous gland or of an ulcer; intestinal obstruction from a strangulating band; or, as has been suggested, thrombosis in the mesenteric vessels, causing sudden paralysis of a segment of intestine. The ascitic fluid contains the bacilli in very small numbers only, so that they are rarely discovered by ordinary microscopic examination. By Jousett's method of inoculation, the bacilli may, however, usually be detected. In this respect, the ascitic fluid is analogous to the effusion in tuberculous pleurisy.

DIAGNOSIS.—The diagnosis, as a rule, presents no especial difficulty, as in a large number of cases evidences of tuberculosis are found elsewhere in the body—the lungs, the Fallopian tubes, the testicles, etc. In children tuberculosis is the most common cause of ascites. From *typhoid fever*, which it very often resembles, it

can usually be distinguished by means of the biological tests. In cases of doubt between tuberculous peritonitis and *cirrhosis of the liver*, the history is usually of assistance in the case of adults, although in the rare instances of cirrhosis of the liver in children the difficulties are considerably greater, such cases being usually taken for tuberculous peritonitis. The association of the two conditions has been pointed out. A point of some importance is the cytology of the fluid: In tuberculous peritonitis the lymphocytes usually predominate, while in cirrhosis of the liver there are few if any lymphocytes, and endothelial cells are chiefly found. The fibroplastic form may be difficult to distinguish from *malignant infection of the peritoneum*. Here, again, examination of the fluid may be useful.

Physical sign which has proved very helpful in differentiating abdominal enlargement associated with rachitis from that of tuberculous peritonitis. Whereas in rachitis the greatest prominence of the abdomen is manifested at the epigastrium, in tuberculous peritonitis the abdominal circumference is largest at or below the umbilicus (hypogastrium). This differential physical sign can best be elicited by careful measurements of the abdominal circumference by means of a tape-measure, but can readily be determined also by mere inspection. It can be explained by the fact that in tuberculous peritonitis the inflammatory exudate accumulates at the bottom of the abdominal cavity and thus distends the surrounding abdominal wall. To make correct use of the sign, however, one must be sure to exclude large dermoid cysts of the ovary and an overdistended bladder, both of which are apt to lead to diagnostic errors. Herman B. Sheffield (Med. Rec., Aug. 30, 1913).

Certain uncommon cases of tuberculosis of the peritoneum present the macroscopic characteristics of malignant papilloma. Mistakes in diagnosis and prognosis are easily made in these cases unless the pathological tissue removed is histologically studied. R. T. Morris (Arch. of Diag., April, 1914).

PROGNOSIS.—It is generally admitted that spontaneous cure is possible in peritoneal tuberculosis; and this in part explains the good results that have been attributed to treatment by means of laparotomy. Complete cure is, of course, rare; but temporary improvement of variable duration is not infrequently observed. The proportion of permanent cures has been estimated as high as 50 per cent. Unfavorable factors influencing the outcome are: persistent fever, wasting and diarrhea, the presence of complications such as pulmonary tuberculosis, intestinal ulceration, meningitis, and the development of localized abscesses. After apparent cure there is a marked tendency to recurrence, due to the persistence of some undiscovered source of reinfection, indicating the necessity of removing any local focus that may be found in the Fallopian tubes, intestines, glands, or elsewhere. A remote effect of tuberculous peritonitis is the formation of peritoneal adhesions, and the danger of mechanical strangulation of the intestine to which they may give rise. This complication, however, is not very common.

The prognosis of tuberculous peritonitis is good. Ochsner states that 50 per cent. are cured by medical treatment alone and that 50 per cent. of the remainder are cured by surgical intervention. Cases should be well for at least 3 years before pronounced cured. The chronic ulcerative

caseating variety presents the least chance of recovery with either method of treatment. Cashman (Am. Jour. Med. Sc., cliv, 269, 1917).

TREATMENT.—The advisability of laparotomy in the treatment of tuberculous peritonitis is a question still in dispute.

[Numerous statistics have been collected, both by surgeons and by physicians. F. C. Shattuck reported 37.5 per cent. of deaths among 52 cases treated surgically, as against 68 per cent. in 46 cases in which no laparotomy was done. The latter, however, were complicated by tuberculosis elsewhere in the body. Elastratov found 68.4 per cent. of deaths among 136 cases treated medically, and 21.7 per cent. among 240 cases treated surgically. Roersch analyzed a series of 358 operative cases, of which 71 per cent. recovered. Statistics showing a greater percentage of recoveries among cases treated medically are, however, not wanting. Sutherland, Borchgrevink, Pfenger, Saltykow, and others have collected series of cases in which the percentages of recoveries were greater among the cases treated medically than among those subjected to laparotomy. Thus, as high as 82 per cent. of recoveries under medical treatment were reported. R. M. GOEPP.]

The advocates of medical treatment do not deny that a large number of cases have recovered after surgical treatment, but they insist that the good effects are to be attributed as much to the natural tendency of the disease toward spontaneous recovery as to the operation itself. It is also stated that paracentesis, with the injection of iodoform emulsion in glycerin, gives as good results as laparotomy.

Schramm found 80 per cent. of cures among the operated children and 64 per cent. among the non-operated; Pic observed recovery in 74 per cent. of the operated patients and in 5 per cent. only of the non-operated; Wutherland observed re-

covery in 50 per cent. of the operated patients and in 81 per cent. of the non-operated. By adding up all the operated patients we get 88 cures, or 70.4 per cent., in 125 cases, as contrasted with 51 cures, or 33 per cent., in 156 patients not operated on. The **operation** on ascitic cases should be tried after **hygienic and medical treatment** has been given a fair trial for a month or so without any definite benefit. Simple paracentesis is not often necessary and is seldom practised. After **removal** of some of the **fluid**, **injections** of various kinds through a cannula have been employed; thus **sterilized air**, **oxygen** (Schulze), **isotonic salt solution**, **epinephrin** (adrenalin) (Wynter) have been reported to give good results. The injection of **camphorated naphthol** is **dangerous** (Guinard). Rolleston (Brit. Med. Jour., Sept. 2, 1911).

Injection of nitrogen was tried by the author, in a young man who developed tuberculous peritonitis with recurring ascites. There was no benefit from laparotomy twice repeated, Röntgen exposures, or incisions. After tapping and withdrawing 2.5 liters (quarts) of ascitic fluid, the author injected 500 c.c. (1 pint) of **nitrogen** into the peritoneal cavity by the ordinary artificial pneumothorax technique. Nine days later 600 c.c. (1½ pints) were injected without withdrawing the effusion present. A third and a fourth injection of 800 c.c. (1¾ pints) and 600 c.c. (1½ pints) of nitrogen followed, all in the course of two months. The patient improved rapidly and the abdomen appeared free from ascites. Eight months after the beginning of the injections, the patient seemed entirely cured. Bruckner (Berl. klin. Woch., Jan. 19, 1914).

The following **operative treatment** in tuberculous peritonitis in 31 cases (27 adults) yielded improvement, usually very marked, in all but 4 cases. An incision 3 to 4 inches long was made through the sheath of the right rectus and the patient eviscerated in so far as possible, the intestines be-

ing caught in a nest of hot, moist towels and thoroughly washed with a solution of 50 per cent. commercial **hydrogen dioxide**. The abdominal cavity was then thoroughly flushed with the same solution, after which it was washed with equal thoroughness with normal **saline solution**, as were also the intestines. The latter were then replaced and the wound closed with 3 layers of sutures. Primary union followed in every case. The patient must be got out of bed and about as soon as possible. Judd (N. Y. Med. Jour., June 6, 1914).

The cases of tuberculous peritonitis in which surgical treatment promises to be of great aid, divide themselves into two groups. 1, and most favorable are those cases in which a definite anatomic portion or viscus of the peritoneal cavity is involved, such as the Fallopian tubes, the ileocecal coil and the appendix, which can be removed. 2, and less favorable, are those in which the peritoneal cavity contains a considerable quantity of fluid occupying either the entire peritoneal cavity or a large part of it, or in which the fluid is contained in loculi composed of peritoneal adhesions, dividing the peritoneal cavity into compartments containing fluid. The writer emphasizes the importance of removal of diseased Fallopian tubes in women with tubercular peritonitis. W. T. Mayo (Jour. Amer. Med. Assoc., July 6, 1918).

Tubercular peritonitis most frequently attacks young women. As operation cures most cases, large tubercles being absorbed, even those of the tubes and uterus, they should not be sterilized. Carstens (Amer. Med. Assoc. Trans.; N. Y. Med. Jour., June 21, 1919).

In deciding this question it should always be remembered that the cases subjected to operation are selected cases, and that the statistics in a series of this kind are, therefore, likely to be more favorable. Extensive tuberculosis elsewhere is re-

garded as a contraindication to laparotomy, and only those cases with effusion are, as a rule, selected. A conservative statement is that laparotomy probably exerts a hastening influence on cases that already tend to spontaneous cure. Operative treatment, therefore, should be resorted to in favorable cases, after a reasonable length of time (say four to six weeks) has elapsed under careful hygienic and medical treatment, without any definite evidence of improvement, and whenever there is a definite surgical indication, such as the presence of localized abscess, or of a tuberculous focus that can be removed surgically.

The **fresh-air treatment** is as applicable to intestinal as to pulmonary tuberculosis, and is particularly important in the case of children. Diarrhea is a symptom that requires attention. If the stools are offensive **guaiacol** should be administered, and, if necessary, one of the **bismuth salts**. **Codliver oil** and the **syrup of the iodide of iron** are still popular, especially in pediatric practice. The **tincture of iodine** has been applied externally.

Four cases of tuberculous peritonitis in which the writer painted the peritoneum with **tincture of iodine**, using a 10 per cent. solution, which he applied not only to the peritoneum, but also to the omentum and to the intestines. He then closed the incision. He observed, forty-eight hours after the operation, a chemotactic peritonitis without fever, after which time recovery followed without interruption. Hofmann (Münch. med. Woch., March 5, 1912).

The writer made a trial of the method originally recommended by Grocco in the treatment of tuberculous peritonitis, viz., the subcuta-

neous injection on alternate days of $\frac{1}{2}$ to 1 dram (2 to 4 c.c.) of the following solution:—

R Iodine,
Potassium iodide,
of each ʒv (20 Gm.).
Normal saline solu-
tion ʒviss (200 Gm.).

Mix and make into a solution.

Relief from the local symptoms and improvement in the general condition were obtained. At times the injections proved to be painful. Where this is the case an **ointment of iodine** may be used instead.

In cases that have been subjected to celiotomy the iodine treatment is a most effective adjuvant, accelerating repair of the peritoneum and preventing complications. Pontoizeau (N. Y. Med. Jour., from Lyon méd., Jan. 4, 1914).

Mercurial ointment has also been used locally. It is doubtful, however, whether these remedies add anything to the good effects of general **hygienic treatment**.

Air was injected in peritoneal cavity after paracentesis by the writer in 3 cases of the exudative type, with recovery. After removal of the exudate by trocar, the air is forced in by emptying water from a large syringe into the aspirator jar. Florio (Gaz. degli osped., Jan. 2, 1910).

Case of tuberculous peritonitis in a boy of 10 years in whom, after removal of the ascitic fluid, the incised peritoneum was sutured with the exception of a small area through which **oxygen** was passed into the abdominal cavity by means of a blunt glass tube. The abdomen was distended until the wall was moderately tense, the tube withdrawn, and the wound closed. The ultimate result was excellent, recovery taking place. Webb has administered oxygen intraperitoneally in a number of additional cases in human beings, with beneficial results. The writer warms the gas to about 100° F. After ascertaining that

the liver is not adherent to the abdominal wall he distends the abdomen until liver dullness is obliterated. A tendency to collapse after the oxygen had been absorbed, *i.e.*, after twenty-four hours had elapsed, was observed in some patients whose condition was very poor. In employing the measure, this tendency should be guarded against. Meeker (Inter. Jour. of Surg., Aug., 1912).

After operation in this disease, it is important to exert a persistent influence upon the process in the affected peritoneal cavity. This can best be done by leaving a concentrated solution of sugar in the abdominal cavity, particularly in the deeper portions, after laparotomy. F. Kuhn (Arch. f. klin. Chir., Bd. xcvi, Heft 3, 4, 1912).

Good results have been obtained with lime, a non-fluid and salt-free diet, drinking very little if at all (to combat the diarrhea), a wet compress continuously on the abdomen, covered with oil-silk, and complete bed rest with the windows all open. The lime is given according to Ferrier's formula, omitting the magnesia: 0.65 Gm. (10 grains) calcium carbonate; 0.2 Gm. (3 grains) tribasic calcium phosphate, and 0.15 Gm. (2½ grains) sodium chloride. One such capsule to be taken three times a day after meals. This method seems most promising in the cheesy and ascites cases. Anorexia, vomiting and diarrhea are the chief indications for it, and also tuberculous lesions in the lungs, etc. Périer (Annales de méd. et chir. infant., April 15, 1912).

The solar cure, or heliotherapy, regularly brings about cessation of the subjective manifestations in a rather brief period and disappearance of the exudate after a longer interval. Seashore treatment will yield approximately the same results, especially during the period of convalescence. It is of advantage to combine the two methods whenever possible. Gaubert (Paris méd., Oct. 18, 1913).

In 2 apparently hopeless cases of tuberculous peritonitis in children the

writer found the administration of the following mixture very beneficial:

R. Calcii carbonatis
 (*precip.*) 8 Gm. (2 dr.).
Olei creosoti 2 c.c. (32 min.).
Mucilaginis tragacanthi q. s.
Potassii iodidi .. 1 Gm. (16 gr.).
Saccharini 0.50 Gm. (8 gr.).
Olei menthæ pip.
vel anisi 0.33 c.c. (5 min.).
Aq. ad 240.0 c.c. (8 oz.).

Dose.—Two drams every four hours for a child of 5 years.

Tincture of opium or compound tincture of camphor may be added for the relief of pain and diarrhea, if present. The patients were two boys, aged 3 and 5 years, respectively. Lawrie (Brit. Med. Jour., Nov. 29, 1913).

Falk having obtained cure in guinea-pigs with peritoneal tuberculosis by means of X-rays, the writer used the deep rays in 11 cases with eminently satisfactory results, the average duration of treatment being from 8 to 10 weeks. The dose was regulated by the increase in the patient's weight. Paul Eisen (Amer. Jour. of Röntgenol., Jan., 1917).

Good results have been reported from the treatment of tuberculous peritonitis by means of vaccine therapy, according to the reports of numerous writers, experimenting with a variety of different tuberculins. The tuberculin may be administered by mouth or in the usual manner, by hypodermic injection.

Case of tuberculous peritonitis treated on the principles of aut drainage recently advocated for the treatment of hydrocephalus. The author made a permanent fistula leading from the peritoneal cavity to the subcutaneous tissue through the separated recti muscles. The skin incision was closed tightly. The ascites was thus drained and the reabsorption of the fluid induced by an auto-

serotherapy. The patient improved rapidly, gaining 25 pounds in weight, and there was no return of the ascites. Evler (Med. Klinik, Bd. vi, 627, 1910).

TUMORS.

Non-malignant tumors of the peritoneum, which include tumors of the omentum and mesentery and retroperitoneal tumors, may be divided into solid and cystic.

Fibromata.—Pure fibromas are rare, and are usually found in connection with the mesentery, omentum, or retroperitoneal space. They are commonly single and may attain considerable size. A type of so-called fibrosarcoma (although non-malignant) of the anterior wall is described, occurring particularly in multiparous women during pregnancy. These tumors arise from the aponeurosis or from the tendons or the sheaths of the muscles; possibly, also, from the round ligament of the uterus. They are benign. When discovered during pregnancy, removal is not indicated, as the operation would unnecessarily weaken the abdominal wall.

Fibromyomata occasionally arise from the mesentery. This fact is interesting chiefly as showing that these tumors do not always arise from the uterus or the broad ligament. Clinically, they usually resemble the ordinary uterine fibroid, and the diagnosis is correspondingly difficult.

Lipomata may develop from collections of fatty tissue in various regions of the abdomen, such as the hernial orifices, the fat surrounding the kidneys and the fatty tissue in the iliac fossa and the retroperitoneal space. These tumors occasionally attain considerable size. They may be detected by palpation, although,

owing to their soft consistency and the yielding nature of the surrounding tissues, this may present a good deal of difficulty. As they are often semifluctuating, they may be mistaken for encysted ascites, or they may be confused with ovarian or hydatid cysts.

The operative technique presents a difficult problem, particularly when the lipoma is retroperitoneal, on account of the difficulty of avoiding the vessels running to the intestines, so as not to cut off their blood-supply.

Cysts.—The most important are the parasitic cysts which give rise to *hydatid disease* of the peritoneum. These cysts, as is well known, represent the bladder stage of *Tænia echinococcus*, which exists as a tapeworm in the dog and related animals. Dissemination of the cysts on the peritoneum is believed to result from the rupture of a single primary cyst, usually in the liver. The number of these peritoneal cysts may be enormous, and they may be scattered over the entire omentum, mesentery, and visceral peritoneum, the omentum and pelvis being the most frequent sites. They vary in size from a pinhead upward, and are either sessile or pedunculated. A variable degree of chronic peritonitis may result from the mechanical irritation caused by them, in places leading to considerable thickening over the cysts. Occasionally these cysts break down and produce localized abscesses. The disease progresses very slowly, with gradual enlargement of the abdomen. The cysts are freely movable, and are apparently not connected with any of the viscera, as they change their position with movements of the patient's body.

The hydatid thrill is rarely obtained. If the enlargement becomes very great respiration may be embarrassed, and the symptoms of indigestion, constipation, etc., may develop. Various pressure symptoms may also be manifest, depending on the location of the cysts. Pressure on the inferior vena cava produces distention of the superficial veins; pressure in the pelvis is responsible for rectal and urinary symptoms, vesical pains, frequent micturition, constipation, and a feeling of weight in the perineum.

In the *diagnosis* the history of a hydatid cyst of the liver that has been tapped is strongly in favor of hydatid disease.

In women hydatid disease may be mistaken for *uterine or ovarian tumor*. *Malignancy* may usually be excluded by the slow course of the affection and the fact that the tumors are cystic. Puncture of the cysts, which was formerly resorted to, is now condemned on account of the danger of hydatid fluid escaping into the peritoneal cavity. When, however, this is done for exploratory purposes, the discovery of the characteristic hooklets makes the diagnosis certain.

The *treatment* consists in radical **removal**, whether the cyst be single, or multiple cysts be present. In the latter case operation is equally indicated, but the results are less satisfactory. **Tapping** through the abdominal wall should not be done, but when there is a single cyst in the pelvis it may be evacuated through the perineum or vagina.

Cysticercus cellulosæ is, in very rare instances, encountered in the abdomen, but gives rise to no clinical symptoms.

Mesenteric Cysts.—These include, besides hydatid cysts, *sanguineous* and *dermoid* cysts. They are usually unilocular, and the character of their contents is quite variable. The fluid may be clear, containing albumin and cholesterin; turbid, due to the presence of blood-corpuscles; viscid, from an admixture of mucin, or chylous, when it contains chyle. The symptoms produced by the presence of these cysts are not characteristic, being those of a gastroenteritis. Occasionally there may be acute attacks of abdominal pain, which may lead to an examination of the abdomen and the discovery of the tumor. This is round, well defined, tense, movable, and usually found on the right side of the abdomen, a little below the umbilicus. The differential diagnosis must be made from a *distended gall-bladder, floating kidney, ovarian cyst with a long pedicle, pancreatic cyst*, and even an *appendicular abscess*. Diagnostic exploration is not permissible, nor should the cyst be tapped through the abdominal wall for purposes of treatment. The latter consists in **enucleation of the cyst** when possible, or in **drainage**.

Omental Cysts.—These have been described by various writers. Their presence has never been diagnosed, however, before opening of the abdomen. Large omental cysts may simulate a *loculated tuberculous peritonitis* or an *ovarian cyst*. Other conditions that must be considered in the diagnosis are: *lipomata, mesenteric and pancreatic cysts, aortic aneurism*, and *large cysts of the spleen*.

Dermoid Cysts.—Dermoid cysts have occasionally been found in the peritoneum, without any direct connection with the ovaries. Such tu-

mors, or teratomata, have been found between the layers of the mesentery, omentum, and transverse mesocolon, and in the retroperitoneal space. A dermoid cyst may, however, become detached from its ovary and adhere to the peritoneum. These cysts are found only in the female sex.

Malignant Tumors.—Malignant tumors may be either primary or secondary, and are far more common in the peritoneum than are the benign tumors previously discussed.

Primary malignant tumors of the peritoneum are *sarcomata* or *endotheliomata*, which appear in a variety of forms—spindle-cell or round-cell, alveolar, myxosarcoma and lymphosarcoma, and endothelioma. Some of the endotheliomas resemble alveolar carcinoma. Pigmentation is due to the presence of blood. These tumors take their origin from the endothelial layer of serous membranes, from the subserous connective tissue, or from the remains of embryonal structures—the Wolffian bodies, Müllerian ducts, and accessory adrenal bodies.

Retroperitoneal tumors may be difficult to distinguish from similar tumors arising from the organs situated behind the peritoneum—that is, the kidneys and suprarenals. A retroperitoneal sarcoma most frequently arises in the lumbar region, and oftener on the right than on the left side. There is usually some local inflammatory change with adhesions.

The *diagnosis* of these tumors is exceedingly difficult, and it is particularly hard to determine whether the suspected tumor is malignant or benign. Malignant growths, as a rule, progress more rapidly and cause more constitutional disturbance. They are also more likely to produce pain and

pressure symptoms, such as dilatation of the abdominal veins, than is the case with benign tumors. The *prognosis* is extremely grave, particularly when operative interference is impracticable. Some recoveries are, however, reported, when the sarcoma is removed early.

Secondary Malignant Disease of the Peritoneum.—This is sometimes spoken of as malignant peritonitis. The primary growth is usually situated in one of the abdominal organs, although metastasis may occur through the lymphatics from the chest or mammary gland. Occasionally the primary growth is in the testicles. In general sarcomatosis of the peritoneum metastasis probably takes place through the blood-stream.

The disease is more frequent in women than in men, probably on account of the greater frequency of malignant disease in the sexual organs and in the mammary gland of that sex. Sometimes the carcinomatous and sarcomatous growths are very small, resembling the miliary tubercles of tuberculous peritonitis, and the term “miliary carcinomatosis” is occasionally employed. From these very minute nodules the size varies to masses of considerable magnitude. In women the ovaries often become involved secondarily. The regions most frequently affected are the omentum, the mesentery, and Douglas’s pouch. An interesting point is the occasional spreading of the process upward through the thoracic duct and enlargement of the glands above the left clavicle, which is accordingly an occasional diagnostic sign of some value. The absence of this sign, however, has no negative value whatever. Ascites is often

present and, owing to the formation of adhesions, may take the form of loculated collections of fluid.

The *symptoms* are those of cancerous cachexia—gradual loss of strength and flesh, anorexia and general discomfort in the abdomen. These symptoms are due in part to the primary growth in some of the abdominal viscera, and in part to the secondary cancerous peritonitis. Pain is an uncertain symptom and may or may not be present, depending somewhat on the degree of local peritonitis. Ascites is commonly present and may obscure the presence of any growth. The ascitic fluid may be clear, turbid, blood-stained, or chylous. The degree of distention varies. Dilatation of the abdominal veins may be great when there is pressure on the inferior vena cava. The veins do not converge toward the umbilicus, as in the case of portal obstruction. The skin of the abdomen becomes flaccid, and the general signs and appearances of cancerous cachexia develop. Pigmentation may be present, not only on the abdomen, but also on the face. Edema of the feet is a late symptom, due either to pressure on the inferior vena cava or cardiac weakness. Tumors may or may not be palpable through the abdominal wall, according to the quantity of ascitic fluid present. When the latter has been removed by tapping, the growths may become accessible to palpation. The disease rarely lasts more than six months.

The *diagnosis* can be made definitely only when tumors are clearly present in a patient who is known to have malignant disease of some of the abdominal viscera. In the absence of such a history, the condi-

tions to be considered are tuberculous peritonitis, and possibly multiple hydatid cysts of the peritoneum. *Tuberculous peritonitis* may be recognized by injecting some of the fluid into guinea-pigs, or perhaps by means of the tuberculin test. Blood-stained fluid is always in favor of malignant disease. The possibility of fecal accumulation should not be forgotten, and the intestinal tract should be thoroughly emptied by means of purgatives and enemas before a definite diagnosis is made. *Hydatid disease* has been discussed. The presence of enlarged glands in the groins and above the left clavicle is of some importance, particularly in those cases in which no tumors can be felt.

Occasionally microscopic examination of the fluid withdrawn may reveal the presence of small fragments of growth. Large numbers of multinuclear endothelial cells, and of cells with typical or atypical nuclear figures, are in favor of malignancy.

Treatment.—This limits itself to the **relief of pain and gastrointestinal distress**. The fluid should always be removed and **adrenalin** then injected into the peritoneal cavity.

General carcinomatosis of the peritoneum as shown by 4 personal cases sometimes yields to **deep X-ray**. But the possibility of metastasis imposes a guarded prognosis. Pfahler (Amer. Jour. Röntg., v, 319, 1918).

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PERITONITIS. See PERITONEUM, DISEASES OF.

PERLECHE. See MOUTH, LIPS, AND JAW, DISEASES OF.

PERNICIOUS ANEMIA. See ANEMIA, PERNICIOUS, PROGRESSIVE.

PERNIO (CHILBLAIN; TRENCH FOOT; FROST-BITE).

—Pernio is a pathological condition of the skin due to damp cold. During the war it was known as "trench foot;" it caused much hardship.

SYMPTOMS.—In mild cases there is slight redness, swelling, itching, and burning of the part. These symptoms all become intensified in severe cases, and the inflammation may be so great that vesication and ulceration result.

Chilblains may be followed by a general tumefaction of the regions attacked, which is the result of local asphyxia even more than of chilblains themselves. In the hands and toes this tumefaction gives a peculiar, sausage-like aspect to the parts, somewhat like that resulting from acromegaly. Localized and persistent vascular dilatations, true acquired capillary angiomas, studded with small papillomata may also occur.

As **trench-foot**, during the war, it occurred in three grades of severity: 1, painful anesthesia, edema and redness; 2, superadded phlyctenulæ and scars; 3, gangrene, often mutilating, followed by septicemia and sometimes death. Tetanus and gaseous gangrene are also observed. The third grade is encountered in about 1 per cent. of all cases in men who have been long in the trenches, particularly in certain trenches—a fact which has caused trench-foot to be regarded as a mycosis by some observers. Soldiers from warm countries and colored men were especially predisposed to it. There is less itching in trench-foot than in chilblain owing to the greater severity of the morbid process.

ETIOLOGY AND PATHOLOGY.—

Defective or insufficient alimentation facilitates the development of chilblains; inactivity also assists; cold, aided by defective conditions of circulation and of functions of the economy, is their main cause. It exerts still greater effects when the skin is wet or not properly dried, or when it is suddenly succeeded by heat.

A slight increase of transudation converts the water-logging of the tissues into perfectly definite hematoma such as are seen in chilblains. The subjects of malarial cachexia are not infrequently also the sub-

jects of chilblains, which are also of very frequent occurrence in hemophilic families.

Trench-foot was mainly observed in men who in the trenches were subjected to prolonged standing, long immobility, fatiguing positions such as crouching, prolonged stays in boggy, flooded trenches, wet dug-outs and shell-holes. Another potent factor was the impediment to the venous circulation of the legs caused by that product of ill-advised military economy, the puttee. The Belgian soldiers, who were not provided with puttees, suffered with extreme rarity from trench-foot.

TREATMENT.—For chilblains, Sir A. E. Wright recommends measures to increase coagulability of the blood. **Calcium lactate**, 5 grains (0.3 Gm.) is indicated, also cautioning patients against lowering their blood coagulability by the ingestion of sour fruits, alcohol, or excessive quantities of fluid.

A solution of **acetate of zinc**, 1 dram (4 Gm.) to the pint (500 c.c.) of water, applied to the foot is said to give almost instant relief.

Codliver oil, preparations of **iodine**, **iron iodide**, and **arsenic** are indicated in all cases. Brocq recommends the association of **quinine sulphate** and of **ergotin** (in doses of from $\frac{3}{4}$ grain to 3 grains—0.048 to 0.2 Gm.) with powdered **digitalis** (from $\frac{1}{5}$ to $\frac{1}{3}$ grain—0.013 to 0.02 Gm.) and the extract of **belladonna** ($\frac{1}{2}$ grain—0.03 Gm.). Brocq recommends the following powder:

R Bismuth salicylate 10 Gm. (2½ dr.).
Cornstarch 90 Gm. (3 oz.).

As a preventive, friction with camphorated alcohol is useful. For the severe itching the following lotion may be rubbed in:—

R Glycerin,
Rose-water,
of each 50.0 Gm. (1½ oz.).
Tannin 0.10-1 Gm. (1½-15 gr.).

To preserve the hands one may also apply the following cream:—

R Lanolin 60.0 Gm. (2 oz.).
Oil of sweet almonds 50.0 Gm. (1½ oz.).
Petrolatum 0.001 Gm. (1/60 gr.).
Essence of rose . 10.0 gtt. (10 drops).

Regular exercise, walking, gymnastics, cold affusions, and general stimulating lotions represent extremely useful prophylactic means in the majority of subjects. The hands should be covered with thick and sufficiently warm gloves, but rough woolen gloves should be avoided. They, like the feet, should be washed in warm water (not in cold) and carefully dried on a towel (never before a fire), and then powdered with starch or talc in order to remove every trace of dampness. The hands should not be allowed to remain too long in cold or soapy water.

Shoes and stockings should be comfortably large; they should be thick enough to protect the feet against the action of the cold. If sweating accompanies the chilblains, repeated foot-baths must be resorted to. Foot-baths containing small quantities of astringent decoctions of walnut-leaves, of ash-leaves, of eucalyptus-leaves, of oak-bark, etc., of from five to six minutes' duration, constitute a very useful means of preventing frost-bite.

When the lesions are due to hyperemia with little or no infiltration of the skin, zinc-oxide ointment, such as the following, to which has been added a small quantity of carbolic acid or menthol, will suffice to allay the pruritus and cause the rapid disappearance of the lesions:—

℞ Zinc oxide 150 gr. (10 Gm.).
 Phenol 8 gr. (5 Gm.).
 Petrolatum,
 Lanolin, of each 225 gr. (15 Gm.).

M.

If there is active inflammation, the preferable treatment is with an ointment containing lead salts, such as the following:—

℞ Lead subacetate . 30 gr. (2 Gm.).
 Carbolic acid ... 8 gr. (0.5 Gm.).
 Zinc oxide 225 gr. (15 Gm.).
 Petrolatum,
 Lanolin, of each 300 gr. (20 Gm.).

When chilblains resist these topical applications, ointments containing silver nitrate, or painting with 50 per cent. solution of silver nitrate or with the tincture of iodine, often hastens their resolution.

If blisters form they should be opened aseptically and covered with a dressing of petrolatum and boric acid, or with freshly

prepared carron oil to which has been added 2 per cent of carbolic acid. If these blisters have been ruptured, or the chilblains are ulcerated, after bathing the parts with a weak solution of corrosive sublimate they should be covered with a dressing of petrolatum and boric acid, or with non-irritating plasters, such as zinc oxide, simple boric acid, and dermatol plasters, or Vidal's red plaster.

When the ulcerations do not disappear they should be touched every two days with a silver-nitrate stick, or with tincture of iodine, and dressed with camphorated brandy, with Van Swieten's solution diluted one-half with water, or with aromatic wine. These dressings should be carefully applied, particularly on the toes and between the fingers, where, according to Besnier, it is well to place small tampons of absorbent cotton.

Boeck states that resorcin is efficacious in treatment of chilblains, especially when associated with ichthyol and tannic acid, as follows:—

℞ Resorcin,
 Ichthyol,
 Tannic acid, of each 1 part.
 Water 5 parts.

The affected parts are painted with this liquid every evening, the bottle being well shaken before using. It can only be used for the feet, as it blackens the skin. It can, however, also be used for the hands by omitting the tannic acid.

Trench-foot.—The prevention of trench-foot includes the elimination of the band puttee and the wearing of boots permitting free circulation of feet and legs, and freely greased to prevent penetration of the leather by water. Measures to provide the men with dry shelters. Careful cleansing of the feet and greasing of socks; frequent changing of latter. Well greased foot rags well paraffined are more comfortable than socks unless the latter are whole and fit well, though loosely. The use of trench-foot wash-houses where the feet are soaked with a solution of soft potash soap 1000 parts, powdered camphor 25 parts, and sodium borate 100 parts, then dried and dusted with a powder composed of camphor, talc and sodium borate has proven effective. Warm food and bever-

ages should be served to men in the trenches to sustain the general circulation.

The medical treatment for milder cases is similar to that for ordinary pernio. Tepid foot baths with borated camphorated soap, followed by large borated camphorated dressings. In the more severe cases, recumbency for 2 to 3 weeks, with the feet elevated, is advised. For pain, 2 grains (0.12 Gm.) of acetphenetidin and 7 grains (0.45 Gm.) of sodium salicylate 3 times a day are useful (Bell). Potassium iodide internally has been found valuable by Sweet, Norris and Wilmer. S.

PEROXIDE OF HYDROGEN.

See HYDROGEN DIOXIDE.

PERTUSSIS (WHOOPIING-COUGH). —DEFINITION.—An acute infectious disease characterized, at the onset, by catarrhal symptoms of the upper respiratory passages, and, toward the end of the second week by a peculiar convulsive “whoop” or crowing inspiration.

SYMPTOMS.—Pertussis develops after a variable incubation period of from 5 to 13 days, and may conveniently be divided into three stages: the catarrhal, the paroxysmal, and the stage of decline.

Catarrhal Stage.—The symptoms of this stage are those of a more or less severe coryza, which at the onset is unable to be distinguished from that due to other diseases. The cough at this period is not characteristic; gradually, however, it assumes a paroxysmal character and is more frequent during the night than is the case with a cough due to ordinary causes. At this stage it is seldom that any adventitious sounds are to be heard in the chest. There may be slight fever and a dry cough which is not arrested by the usual remedies.

Paroxysmal Stage.—This develops toward the end of the second or dur-

ing the third week. The cough then becomes more violent and paroxysmal, and is characterized by the crowing inspiration termed the “whoop.” The child recognizes its oncoming and endeavors to suppress it, or runs to its mother or nurse for support; a series of quickly repeated short coughs burst forth and persist until the chest is in a state of extreme expiration. The effort seems to be exerted mainly toward this and the expiration muscles so vigorously brought into play that the chest is compressed laterally, the sternal region being thus made to bulge out. The face becomes congested and cyanotic, and the eyes suffused and perhaps injected. Then follows the long-drawn inspiration accompanied by the characteristic “whoop.” This may be repeated two or three times. The paroxysm generally ends with the expulsion of a large quantity of clear, thick, tenacious mucus from the upper part of the throat. Vomiting, with complete unloading of the stomach, frequently takes place at the same time. In delicate children, and especially in infants, these paroxysms produce great exhaustion, and the little patient falls back with livid face and pulse almost uncountable; the great strain may also induce tenderness of the respiratory muscles. In some instances the paroxysm is sufficiently severe to cause epistaxis and other hemorrhages, external and internal.

These paroxysms occur at intervals varying according to the period in the disease and the severity of the attack. In mild cases 8 or 10, in severe cases 20 or 30, may occur during the twenty-four hours. Their severity is also variable. Both the fre-

quency and severity of the spasms are greatest during the first two weeks of the spasmodic stage, after which they gradually lessen. In some undoubted instances of the disease the characteristic whoop is quite absent.

Stage of Decline.—This initiates the period during which the paroxysms grow less frequent, to finally cease. In some cases, however, this stage is protracted and is followed by anemia and prostration.

The disease generally runs a longer and more severe course during the late autumn and winter months than during the spring and summer. Impure air, cool draughts of air, and the recumbent posture are apt to increase the frequency and severity of the spasms. The usual duration of the disease is from 2 or 3 weeks to 8 or 10; occasionally it lasts for several months. The presence of adenoid vegetations in the nasopharynx adds to the severity and duration of an attack.

The disease sometimes attacks persons of adult age; in such the spasms may be severe, though the whoop is seldom characteristic. Complications are infrequent in adults, though the patient may be left with a peculiar laryngeal sensitiveness attended by cough under the influence of smoke, loud talking, etc.

COMPLICATIONS AND SEQUELÆ.—More or less tracheitis is present, which, under defective hygienic conditions or undue exposure, readily becomes converted into a bronchitis, adding to the violence of the symptoms. The case becomes still more serious if bronchopneumonia appears: a condition indicated by a sudden rise of temperature and

increased dyspnea. This complication adds greatly to the fatality of the disease. Some emphysema of the lung is probably developed in every serious case; a few instances have been noted where emphysema of the cellular tissue of the mediastinum has occurred: a condition which may go on to general subcutaneous emphysema and death. The digestive system is in every case apt to be more or less deranged; vomiting in some cases is a troublesome complication, and may interfere with necessary nutrition. A catarrhal condition of the intestines producing diarrhea is liable to occur in infants during the summer months.

In all children an attack of pertussis appears to induce an increased irritability of the spinal and cerebral centers.

Convulsions are very liable to occur, due in some instances to merely temporary causes; in others to serious cerebral lesions such as intracranial hemorrhage or thrombosis, and followed by more or less extensive paralysis, and sometimes by disturbances of sight and hearing. Hemorrhage due to mechanical causes is not infrequent; epistaxis occurs frequently; subconjunctival hemorrhage is more rare; intracranial hemorrhage is generally meningeal, intracerebral being distinctly less frequent.

Among the more important sequelæ of the disease are various chronic pulmonary affections: emphysema, chronic bronchitis, asthma, atelectasis, and chronic interstitial pneumonia. It is to be remembered also that after an attack of whooping-cough has run its course latent tuberculosis and syphilis may suddenly show indications of activity, the heart

may show signs of overstrain, and a condition of undue nervous irritability may persist for several months. (Blackader.)

DIAGNOSIS.—The early catarrhal stage being in no way characteristic, it is difficult, except in those cases in which direct exposure is known to have occurred, to distinguish between pertussis and a catarrhal condition arising from other causes. When the paroxysmal stage is reached, the spasmodic character of the cough, its frequency and severity during the night, the suffusion of the eyes, and puffiness of the lower lids, are all suggestive symptoms, but not absolutely diagnostic. Slight ulceration of the frænum linguæ due to the violence of the cough, frequently occurs in young infants in whom the incisor teeth have been cut.

A paroxysmal cough closely resembling that of whooping-cough may be induced by *enlargement of the bronchial glands*. In early infancy laryngeal spasm producing stridor closely resembling the whoop of pertussis may be due to a *catarrhal laryngitis*.

Of diagnostic value is a differential blood-count, pertussis being characterized by a preponderance of lymphocytes, which sometimes reaches as high as 50 or 60 per cent. The polymorphonuclears may be doubled in number. The specific gravity of the urine is high and the urine contains considerable uric acid.

Examination of the blood in 46 cases of pertussis. In all the cases a leucocytosis of from 7600 to 46,000 was found as well as a lymphocytosis, with a decrease in the polymorphonuclears. Comparing the averages in 46 pertussis cases with 10 normal cases, there is an average

increase of 6070 in the leucocyte count, or approximately 33 per cent.; an increase of 1.9 per cent. in the large mononuclears, and of 5 per cent. in the lymphocytes, and a decrease of 6 per cent. in the polymorphonuclears; the transitionals, eosinophiles and mast cells remaining approximately the same. In bronchitis and pneumonia the polymorphonuclear count is much higher than in pertussis, while the lymphocyte count, both small and large, is considerably decreased. McGay (Cleveland Med. Jour., July, 1911).

The following changes may be observed in the blood-picture of pertussis. These are present even in the early catarrhal stages. First, a general leucocytosis which reaches its height about the third week, the total count being about 27,000. In one case, a count of 85,800 was found. Secondly, the lymphocytes are relatively increased during the first four weeks of pertussis. The average is between 58 and 63 per cent. The large mononuclears and transitionals also show a slight increase, the count equalling 6.2 per cent. It is not possible as yet to draw any prognostic conclusions from the blood examination. W. Schneider (Münch. med. Woch., Feb. 10, 1914).

In 345 children with whooping-cough at a dispensary, nearly 30 per cent. were under 12 months, and only 58.3 per cent. were over 2 years old.

The author's experience confirms the extreme contagiousness of the disease during the primary catarrhal stage; some say it is not contagious after the first week, but he thinks it is better to assume 30 days as the limit of infectivity.

He has never seen contagion of other children from the pertussis children taken into the hospital from the fifth to the eighth week, nor from two children in the middle of the third week.

None of the children in adjoining beds even developed a spasmodic cough. Cozzolino (Pediatria, March, 1918).

The complement deviation test of Bordet, of Brussels, is thought to reveal even mild cases which, nevertheless, are capable of propagating the disease.

The **complement-deviation test** is of the very greatest value in the diagnosis of whooping-cough, though Bordet himself, who described the bacillus, concluded that the complement-fixation was not an early sign. Their technique for the test is described as follows: "A small amount of blood was taken from the patient's ear, finger or toe in small test-tubes, or the Wright capillary tubes. This was kept at room temperature or placed in the incubator until coagulation had taken place. Serum was then separated more completely from the clot in the centrifuge. So far in the writer's tests, only the fresh active serum has been used. Two drops of the serum were used in each test. Hemolytic System: The Noguchi system was used, because of its extreme delicacy and because of the small amounts of material, especially serum, required. Antigen: This is the most important factor in the test. The Bordet-Gengou bacillus was obtained in pure culture from the laboratories of Parke, Davis and Co. Most of the work was carried on with this culture. Cultures were also obtained from the H. K. Mulford Company and Dr. F. B. Mallory of Boston. The latter culture came from a strain grown at Theobald Smith's laboratory. Subcultures were made on Bordet's medium, ascitic fluid agar, and broth serum. The antigen was made from seventy-two-hour growths in ascitic fluid agar in the following manner: The colonies, which are very tenacious, were washed off the agar with sterile salt water. An emulsion was made, and the bacteria again washed in salt water. From this a standard suspension was made and 0.1 and 0.2 c.c. of this used in the test. Throughout the tests live bacteria were used. Controls: In each test known nor-

mal and known positive controls were used. In each series of tests the hemolytic system was tried out in the usual manner, using a water-bath at 37° C. for incubation. After primary incubation for half an hour the amount of amboceptor indicated by the preliminary test was added to the final test-tubes, and the tubes again incubated in the water-bath. Final readings were taken within the following hour. In each case independent readings were taken by the two authors without previous knowledge of the clinical history, and the tabulated results were given showing their uniformity of positive reactions in cases of pertussis as compared with other conditions. The writers call special attention to the need of fresh antigen in the test. A. Friedländer and E. A. Wagner (Jour. Amer. Med. Assoc., March 28, 1914).

ETIOLOGY.—The fact that pertussis is highly communicable points strongly to the existence of a specific organism to which the catarrhal and nervous symptoms may be more or less directly attributed. The Bordet-Gengou bacillus is being increasingly accepted as the cause of the disease. It is found in great numbers in the cilia of the superficial epithelial cells, causing local irritation and cough in the respiratory area.

It seems to be confirmed that the bacillus isolated by Bordet and Gengou in the expectoration of children suffering from whooping-cough is the specific agent of the disease, but owing to the great difficulty in cultivating the organism, the discovery was not practically available till they had found the reaction which has now been applied to whooping-cough, syphilis, and echinococcal diseases. Delcourt (Paris méd., Dec. 16, 1911).

The writers obtained material from 3 cases dying of whooping-cough, and observed the lesions in the trachea and the bronchi. The bacillus which they found is probably

identical with that described by Bordet and Gengou, and the chief interest of their observations lies in the fact that the bacteria are found in large numbers between the cilia of the epithelial cells, lying thus on the surface. The cilia are interfered with and perhaps even destroyed; the normal removal of secretion is prevented and the respiratory surface kept continuously irritated, so that cough is produced. The toxic effects of the bacillus, while undeniable, are, nevertheless, relatively unimportant. Mallory and Hornor (Jour. Med. Research, Nov., 1912).

The contagium is thrown off from the respiratory tract, chiefly in the sputum; the disease appears to be readily communicated through the air even for a considerable distance, and appears to be specially contagious during the early catarrhal stage.

Like other infectious diseases whooping-cough generally occurs in epidemics, which are more frequently met with during the spring and autumn months, and in a peculiar way are frequently associated with epidemics of measles, and often precede or follow epidemics of scarlet fever. The majority of cases occur in children under the age of 4 years; it is seldom met with in children over 12 years; in early infancy it is peculiarly severe and fatal. Girls seem to be more readily infected than boys, though very few children who have not been rendered immune by a previous attack of the disease escape it when exposed to contamination.

PATHOLOGY.—In simple, uncomplicated cases slight catarrhal inflammation of the nose, pharynx, larynx and trachea down to the bifurcation may be observed. In severe cases the inflammation may extend to the smaller bronchi. The source

of the cough is probably the cough area in the interarytenoid region, which is usually markedly congested. In fatal cases the tracheal and bronchial glands are found enlarged; more or less extensive catarrhal pneumonia is generally present; frequently we find collapse of lung with associated emphysema.

In going over sections from an acute case of whooping-cough the writer noticed what seemed to be minute organisms packed in large numbers between the cilia of the epithelial cells lining the trachea. Better sections and stains showed the organisms to be minute bacilli, present in great numbers over the surface of each cell. Similar organisms were found between the cilia of the cells lining the bronchi, also free in the bronchial secretion and inclosed in polymorphonuclear leucocytes, but never in the alveoli. The bronchopneumonia is due to contaminating organisms. The action of the *Bacillus pertussis* seems to be largely mechanical. It interferes with the normal movements of the cilia and therefore furnishes a continual irritation which excites the coughing. The organism also secretes a mild toxin, as is shown in three ways: By a slight inflammatory exudation, by a lymphocytosis, and by the production of a specific antibody. F. B. Mallory (Boston Med. and Surg. Jour., Sept. 11, 1913).

The sputum from 156 Copenhagen children with whooping-cough showed the presence of the Bordet-Gengou bacillus in all who had been coughing for 2 weeks; in two-thirds of those who had had the paroxysmal cough for 2 weeks; in one-third after 3 weeks, and only in 3 out of 36 in the fourth week, and only once later than this. Comby (Archives de Méd. des Enfants, Nov., 1917).

PROGNOSIS.—Pertussis is not the benign disease that laymen believe it to be. In point of mortality

it stands third among the diseases of children. It is more than twice as fatal among negroes than in whites. It is more to be dreaded during the winter and early spring months than during summer. The mortality is especially high when an attack appears during early infancy, especially in rachitic or tubercular children, or in children suffering from adenoid growths in the nasopharynx. The disease assumes a specially fatal character in foundling asylums and hospitals, where bronchopneumonia of a severe type is liable to develop. In children over six years of age, serious complications are rare.

Any disease which kills 10,000 children per annum is a serious one. If bubonic plague were to kill that many children in the United States in one year, the whole world would quarantine against our country. A child dead of whooping-cough is just as dead as a child dead of plague. A child whose body is weakened by disease is a potential economic loss to the nation. Whooping-cough is a danger to be avoided and combated in the interest of humanity and the citizens of tomorrow. Rucker (U. S. Public Health Reports, No. 100, 1912).

Whooping-cough, with a mortality of about 7 per cent., and a toll of 10,000 in the United States annually, presents an appalling contrast to the layman's and the average physician's idea of its harmlessness. Eight cases are reported in which 7 were fatal, and 1 patient lived, but required unremitting care for a year and a half, at the end of which time she presented no great promise of physical or mental development. P. H. Sylvester (Boston Med. and Surg. Jour., March 19, 1914).

Statistics showing that whooping-cough is twice as deadly as measles for young infants and 6 times deadlier than diphtheria in Bavaria, 1893-1902. In Basel statistics show that

young infants contract whooping-cough 5 times more than measles and scarlet fever and nearly 10 times more than diphtheria (1875-1891). Whooping-cough maintains its lead in prevalence over the other diseases up to the age of 5. In 1900 there were 14,000 deaths from whooping-cough in Germany, the same figure as for diphtheria. E. Feer (Med. Klinik, May 17, 1914).

In 1913 there were 46 infants with whooping-cough in the writer's service; most of them were bottle-babies and 9 were between 2 and 6 months old. Two succumbed to pneumonia, another of tuberculosis and still another, enfeebled by chronic bowel trouble, died of general debility. The others all recovered; the mortality was thus 8.6 per cent. although, strictly speaking, the whooping-cough can scarcely be held responsible for any of the deaths in this series. The mortality from whooping-cough throughout Switzerland for the decade ending in 1910 shows the proportion of the general mortality to be 1.10 per cent. from whooping-cough; 1.05 from diphtheria; 0.91 from measles; 0.3 from typhoid, and 0.27 per cent. from scarlet fever. The whooping-cough mortality has not declined in Switzerland in recent years while in England it has dropped to one-half the former figure, but it is still four times that of Switzerland. The statistics for other countries are compared with these. All testify that whooping-cough is a serious disease and that it runs a more serious course in institutions than in private homes. D'Espine (Revue Méd. de la Suisse Romande, Aug., 1914).

PROPHYLAXIS.—The child should be isolated and kept from school. Young and delicate children, especially if predisposed to tuberculosis or if they have adenoid vegetations, are particularly sensitive to infection and are prone to have the disease in a violent form.

Rooms previously occupied by a case of pertussis should always be subjected to fumigation followed by prolonged airing if they are to be occupied by a child. All children should be taken away from a house in which a case of pertussis has developed and kept in the open air as much as possible, though not exposed to cold or weather inclemencies. The quarantine should continue until the paroxysmal stage is past.

Well children should be taught that they must not come in close contact with children who "whoop" and, as a method of protection against not only whooping-cough, but many other diseases, they should be thoroughly instructed as to the dangers of trading gum, exchanging pencils, and the other means by which sputum may be transferred from one person to another. The habit of spitting on the hands in playing baseball and of promiscuous kissing should also be discouraged. If it is necessary that children having whooping-cough should go upon the street, they should be plainly tagged, so that other children may be warned. W. C. Rucker (U. S. Public Health Reports, No. 100, 1912).

In New York whooping-cough reported by dispensaries, as well as all other cases that are ascertained to be without the care of a private physician, have been kept under supervision by the district nurses of the Bureau of Infectious Diseases. The nurses are now required to visit and revisit pertussis cases in common with measles, scarlet fever, and diphtheria, and to leave cards of instruction with the family. If there is a private physician in attendance the nurse does nothing further, but instructs the family to keep the child in quarantine and isolated for one week after the first day on which the "whoop" appears. No placards are posted. In families where, in addition to the sick child or children,

there are infants or very young children, care is taken to explain the danger to the latter. Failure to secure observation of isolation is followed by a warning from one of the health-squad patrolman. One week after the first appearance of the "whoop," permission may be given for the sick child to leave the premises, *provided it is accompanied by an adult who will see that the child does not play with other children, enter other homes, attend places of amusement, or ride on street cars, etc.* Children can play in the yard or on the roof, provided no other children are there. (N. Y. Med. Jour., Oct. 24, 1914.)

TREATMENT.—Careful hygiene and judicious management do much to lessen the number and severity of the spasms and prevent complications.

The patient should breathe a pure air not too dry, the temperature of which should not be allowed to vary much from 65° F. (18.3° C.). Older children with pertussis may even go out on fine days during the winter. Cold draughts, strong winds, and sudden atmospheric changes are to be avoided, however, as liable to increase the catarrhal conditions present and give rise to severe pulmonary complications. When the patient cannot be out of doors, owing to climatic conditions, it is well to confine him strictly to two rooms, one of which should be thoroughly aired while the other is occupied. A change of rooms and even of clothes, bedding, etc., sometimes proves very beneficial. Fumigation of the patient's room, by means of a small formalin lamp, during his absence, every few days, is also beneficial.

When the cough persists, a change of climate is desirable, a warm seashore location where the child can be

out of doors continuously being preferable. A **sea-voyage** is particularly beneficial to hasten convalescence.

Nutrition must be maintained; the diet should be **nourishing**, but **simple and digestible**. If vomiting occurs frequently, food must be given in small quantities and at short intervals. **Excitement** of all kinds is to be avoided.

Local Measures.—Antiseptics occupy a prominent place in the treatment of this disease, and many attempts have been made to modify the course of an attack by the topical application of such drugs. Moncorvo claims much benefit from the application of a 1 or 2 per cent. solution of **resorcin** to the nasal passages, pharynx and larynx by means of a brush or spray.

Nasal insufflation of powders, the introduction of ointments or sprays containing **quinine**, or local application of a **silver nitrate** or an **iodine** solution have also been recommended. The great objection to such measures is that every application is resisted by young children.

The writer uses a mixture of **iodine** and **phenol** 0.5 parts with 1.5 parts **potassium iodide** and 15 parts **glycerin** in 100 parts water; with this the writer swabs the nasopharynx for two or three seconds once a day. Keeping the child in **outdoor air** as much as possible is important. Bradt (*Therapie der Gegenwart*, July, 1910).

The writer advises the introduction, in whooping-cough, into each nostril, 3 or 4 times daily, by means of a glass rod, of the following ointment:—

℞ *Quinine sulphate* 1 to 2.5 Gm. (gr. xv to xxxviii).
Lard 10 to 15 Gm. (ʒiiss to iv).

M.

The child should be placed on its back that the ointment may penetrate into the posterior nares. Berliner (*Jour. de méd. de Paris*, July 15, 1911),

The writer recommends **iodine** in pertussis, given as follows:—

℞ *Iodi* gr. xv (1 Gm.).
Potassii iodidi,
Aquæ destillatæ,
 āā ʒss (15 Gm.).

M. et ft. solutio.

This solution is given in sweetened milk in daily (fractional) doses of 4 to 6 drops for infants a year old, 6 to 10 drops for children 2 to 5 years old, and 10 to 15 drops for older children. No phenomena of intolerance ever appear. Where indicated, **quinine** and **bromides** can be added. Cavazzani (*Jour. de méd. de Paris*, Sept. 13, 1913).

Silver nitrate in 2 per cent. solution applied to throat in 95 early cases to prevent spread of infection downward from pharynx. It was found useful in 84 instances. Mucous secretion prevented, and coughing spells due to irritation by secretion minimized. The solution was applied every day; later, on alternate days. Ochsenius (*Therap. d. Gegenwart*, Nov., 1913).

The writer swabs the pharynx with a 2 per cent. solution of **resorcin** in glycerin and water, 1 and 12 parts. Macleod (*Lancet*, Feb. 15, 1919).

The inhalation of an **antiseptic vapor** is an easy method of attaining this object. **Creosote** is the most effective, but **carbolic acid**, **cresolin**, **eucalyptol**, or **thymol** is also useful. A solution of either may be readily volatilized by heat and its vapor be diffused through the air and inhaled unconsciously by the little patient. By this method we obtain not only an antiseptic but an anesthetic action on the respiratory passages, and can unquestionably lessen the frequency and severity of the spasm. The best

results are obtained when the patient is made to breathe a strongly charged atmosphere for one or two hours two or three times a day; but caution must be exercised lest irritation of the kidneys be induced. Inhalations of **oxygen** and **ozone** have also been lauded.

The writer considers **adrenalin** a specific when given as follows: Under 3 years, 2 drops every 3 hours; 3 to 7 years, 3 drops; 7 to 15 years, 4 drops; over 15 years, 5 drops, all given after coughing spells. If in 3 days there is no relief, 1 drop may be added per dose. Dumont (*Tribune médicale*, 55, No. 5, 1921).

Quinine is of advantage, but only after the fourth or fifth year, as it produces emesis in the younger children. Large doses are required, 12 to 15 grains (0.8 to 1 Gm.) daily.

The writer has returned to the old quinine treatment advocated by Binz in 1868. He uses quinine in the form of a 1 to 2 per cent. solution of **quinine hydrochlorate** in doses of 2½ fluidrams (10 c.c.), administered at 8 A.M., 2 P.M., and 6 P.M., in severe cases, also at 11 A.M. The 1 per cent. solution can easily be administered, diluted with milk or water, to children under 1 year of age. To influence the neurotic element of the disease, the writer gives simple **hydropathic packs**. The convulsive stage of whooping-cough is shortened to ten to twenty days in medium and severe cases. Zangger (*Brit. Med. Jour.*, Oct. 15, 1910).

Ozone (the allotropic form of oxygen) is recommended, daily sittings of 10 to 15 minutes, or at least 3 a week, being given, the patient placed at about one and one-half feet from the instrument. The symptoms disappear rapidly, and complications are rare. Labbé, the originator of this form of treatment, has not had a single fatal case during his fifteen years' experience with it. A. Varet (*Rev. de thérap. méd.-chir.*, No. 2, p. 37, 1911).

Good results were obtained from a mixture of methyl salicylate and oil of eucalyptus:—

R *Methylis sali-*

cylatis ʒj (30 Gm.).

Olei eucalypti. ʒiii-v (90-150 Gm.).

Misce.

The mixture was spread in a thin layer on plates or saucers and allowed to volatilize in the patient's room, the vapors exerting both an antiseptic action in the bronchi and an antispasmodic effect. In warm weather the measure is of advantage, in that it affords a simple method of continuous inhalatory treatment, requiring no source of heat or apparatus of any kind. Some patients respond better, however, to the direct use of a spray or saturation of the air with water vapor. Perrin and Remy (*Revue méd. de l'Est.*, Sept. 15, 1913).

In an epidemic of whooping-cough, the disease seemed to be absorbed in every case in which **quinine** was given in large doses systematically for several days in succession and the drug retained. The writer always found exceptional tolerance for quinine in children, no appreciable disturbances having been noted in a number of children in an endemic focus of malaria who took by mistake for malaria 1½ and 1¾ drams (6 and 7 Gm.) of quinine bisulphate. For pertussis he did not hesitate to inject daily 7½ grains (0.5 Gm.) of acid quinine hydrochloride for infants and 15 grains (1 Gm.) for children up to the age of 5. On cessation of the tendency to vomit he gives the drug by the mouth and keeps it up for eight or ten days, by which time the disease has usually completely subsided. F. Andalo (*Policlinico*, July 4, 1909).

Quinine and **antipyrin** can be depended on to abort or attenuate pertussis, but, as usually given, the dislike of the child to take the medicine leads to inadequate dosage or to its total neglect. This can be obviated by injecting a solution of the drug into the rectum. The solubility of

the antipyrin commends it for the purpose and the writer has 15 grains (1 Gm.) dissolved in $6\frac{1}{4}$ fluidrams (25 Gm.) warm water, injected three times a day, for a child over 12, with smaller doses for children younger. No ill effects have ever been noticed on the heart, while, when the injections are commenced early, the disease is frequently aborted. It does not depress the appetite given in this way, and the therapeutic effect seems to be constant and reliable. Senftleben (*Deut. med. Woch.*, Jan. 14, 1909).

Sedative and antispasmodic medicines may be given internally with the object of allaying the nervous irritation and checking the spasm. Among the most generally employed are the **bromides**, **belladonna**, **antipyrin**, and **chloral hydrate**. **Antipyrin** is the best of these and may be given in 1-grain (0.065 Gm.) doses to a 6 months' infant, or in 2-grain (0.13 Gm.) doses to a 2-year-old child. It should be discontinued if pneumonia or bronchopneumonia develops. It may be advantageously combined with **sodium bromide**. **Heroin** is praised by some clinicians.

Bromoform has been very strongly recommended by many writers. It is generally given in alcoholic solution made into an emulsion with gum arabic and syrup, but much caution must be exercised, as the bromoform is liable to be precipitated and thus be present in poisonous amount in the last doses in the bottle. The latter should always be well shaken. A better plan is to order it to be **dropped on** a lump of **sugar** and given in this way to the child. It is not suitable for young infants. One to 3 drops may be given to a 2-year-old child. Caution should be used in the use of large doses.

Ethyl carbamate was found valuable by the writer to prevent nervous phenomena after the disease has run its course. Dose $\frac{1}{2}$ to 2 Gm. ($7\frac{1}{2}$ to 30 grains) in children under 2 years of age. Bertling (*Berl. klin. Woch.*, Jan. 22, 1912).

Belladonna has been recommended. Starting with small doses, $\frac{1}{4}$ minim (0.015 c.c.) of the fluidextract, or **atropine**, $\frac{1}{800}$ grain (0.00008 Gm.) may be used in a child of 2 years, every four hours. The dose is slowly increased, the effects being carefully watched. If the physiological effects of the drug are noted, the dose is then reduced.

The writer prefers the **tincture of belladonna**, beginning with 1 drop, three times a day, and increasing the daily quantity by 1 or 2 drops until mild physiological effects of the drug appear, when the increasing of the dose must be cautiously continued.

A single dose of **antipyrin** at bedtime or a morning and evening dose has been found best. To a child 2 years old, 2 or 3 grains (0.12 or 0.2 Gm.) each night, or morning and night, may be given. **Sodium bromide**, 5 grains (0.3 Gm.) three or four times a day, to a child of 3 years, is often efficacious, and **codeine**, **trional**, **heroin**, and **chloral** are often of benefit in allaying cough and inducing sleep. They may be given in a single dose at bedtime, or, if necessary, two or three times a day. **Quinine lactate**, 10 Gm. ($2\frac{1}{2}$ drams) to **saline solution**, 100 Gm. ($3\frac{1}{3}$ ounces) may be used. Of this 2.5 c.c. (38 minims), warm, are injected intravenously. If given hypodermically into the muscles the effect is favorable, but not as prompt nor as satisfactory as when given intravenously. Graham (*Arch. of Pediat.*, Aug., 1914).

Helpful also are **hot baths** and **mustard baths** as auxiliary measures during the paroxysmal stage.

The writer has always witnessed great relief follow a **hot bath** given

toward evening. The water should be about 99° F. (37.2° C.) and the child should stay in the bath for from ten to fifteen minutes, the head being kept cool with a cold water compress. The children sleep well after it, and the number and severity of the paroxysms seem much diminished. The skin of children with pertussis is pale and cool, indicating contraction of the vessels in the skin. Schrohe (*Therap. der Gegenwart*, Sept., 1910).

In two epidemics of whooping-cough the writer obtained marked success by giving sedatives and counterirritants such as mustard baths and menthol embrocations over the spine. The sedatives comprise chiefly antipyrin, heroin, and sodium bromide. This management, however, must begin during the initial catarrhal stage to be efficacious, and it then operates by curtailing the duration of the second or spasmodic stage. Althoff (*Münch. med. Woch.*, Oct. 22, 1912).

Vaccines, both autogenous and stock, have been used in pertussis in a large number of cases, but their value is still undetermined. They appear to be harmless and may be used in large doses.

The authors used the vaccine prepared from Bordet's bacillus in 40 cases of whooping-cough and in 14 children who had been exposed to the disease. As a prophylactic agent the authors have no hesitation in recommending the pertussis vaccine. As a remedial agent, success depends upon the promptness of administration and the freedom of the patient from complications at the time. In no case should other treatment be withheld if indicated, especially in infants who may be spared convulsions or bronchopneumonia by the use of emetics, sedatives, and some member of the aromatic group. Saunders, Johnson, White, and Zahorsky (*Pediatrics*, March, 1912).

A review of the literature by the writers showed that 1445 cases had

received the vaccine treatment to date. Endorsement is not universal, though various vaccines were used without definite knowledge of the bacteriology of the individual cases. Apparently the vaccine was harmless in uncomplicated cases. The dosage generally was apparently too small. The duration of the disease in the majority of cases reported had not been much under six weeks.

The authors have treated 18 cases of pertussis with vaccine. Some cases will respond favorably to a commercial vaccine. Where a commercial vaccine has not proved successful it would seem desirable to try an autogenous vaccine. The initial dose should be at least 50,000,000 in older children, and this may be doubled at subsequent treatments up to 400,000,000 at five-day intervals. Further observations regarding dosage indispensable. A certain number of cases will not respond favorably to a vaccine, and in those it should be continued after a trial of 4 doses. Harts-horn and Moeller (*Arch. of Pediat.*, Aug., 1914).

The results obtained at the whooping-cough clinic and by over 180 private physicians and health officers warrant the routine administration of pertussis vaccine for both curative and prophylactic purposes. The best time to use it, except as a prophylactic, is the first and second week of the paroxysmal stage. When the proper vaccine is given and the method of the New York Health Department is employed, the disease is materially reduced in duration and severity. The presence of subconjunctival hemorrhages in prophylactic cases which were protected by the vaccine seems to point to its specific immunizing action against the paroxysms and to the fallacy of the hitherto accepted theory that these hemorrhages are due to the violence of the cough. Luttinger (*Jour. Amer. Med. Assoc.*, May 19, 1917).

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PETROLATUM. See PETROLEUM.

PETROLEUM.—Petroleum (rock oil, coal oil, mineral oil) is found in various regions of the world. In the natural state it varies in color from a light green or red to black, more rarely clear. It has a distinctive odor. Some specimens have a very offensive odor due to the presence of numerous sulphur and phosphorus compounds. Barbadoes tar, Seneca oil, and Rangoon oil are thick varieties. The Rangoon oil contains a larger proportion of both the olefin and the benzol series than American oil. It is soluble in fixed and volatile oils and in ether, in 64 parts of boiling absolute alcohol, but is nearly insoluble in water, and in chloroform. It is a solvent for india-rubber and many resins. By fractional distillation and purification, it yields a variety of commercial products, the lighter oils being used as solvents, the heavier being used for light, fuel, and lubrication.

All that portion which distills over at or below 122° F. (50° C.) is designated benzin, gasolene, or naphtha. Hydrocarbons of greater volatility are obtained from naphtha by repeated fractional distillation. Rhigolene is obtained by distillation from naphtha, distilling over at 64.5° F. (18° C.).

By distilling off the lighter and more volatile portions of American petroleum and purifying the residue, petrolatum, or petroleum ointment, is obtained. Petrolatum is an amorphous, pale-yellow to white, odorless, tasteless (or nearly so), transparent, fatty substance, more or less fluorescent. It does not become rancid, and is in most cases a valuable substitute for lard in the preparation of ointments. It can also be obtained as a semiliquid or liquid oil.

PREPARATIONS AND DOSES.—Petroleum (rock oil, crude petroleum), 15 to 30 minims (1 to 2 c.c.), as an intestinal antiseptic.

Petrolatum, U. S. P. (petroleum ointment; petrolatum molle, petrolatum spissum, Pharm., 1890).

Petrolatum album, U. S. P. (white petrolatum).

Petrolatum liquidum, U. S. P. (liquid petrolatum).

Benzinum, U. S. P. VIII (gasolene, petrol, petroleum benzin), 10 to 30 minims (0.6 to 2 c.c.) in mucilage or capsule.

Benzinum purificatum, U. S. P. (purified petroleum, benzin).

Rhigolenum (rhigolene; used in spray for local anesthesia and thermocautery).

PHYSIOLOGICAL ACTION.—Petroleum when taken internally in small doses is stimulant, antispasmodic, diaphoretic, antiseptic, and expectorant. It disinfects the gastrointestinal and respiratory tracts. In large doses it gives rise to headache, vertigo, pain in the stomach, palpitation of the heart, vomiting, and tetanic spasm.

In petroleum poisoning a distinction must be made according as to whether the petroleum vapor is inhaled or the oil has been rubbed into the skin or has been taken internally. It would appear, according to Lewin's researches, that among workers in petroleum springs no ill effect is produced; that is, as long as the vapor is inhaled in the open air; but in factories similar symptoms are produced as by ordinary gas. A feeling of exhilaration is first induced, then heaviness in the head, vertigo, loss of consciousness, or anesthetic sleep. Cyanosis, contracted pupils, and vomiting may occur. Cutaneous hemorrhages, and hemorrhages of the gums, nose, the stomach, and of the genital organs are occasionally noticed. A fatal result may ensue. Chronic bronchitis with anemia may appear after long exposure to the vapor. Rats and dogs shut up in the fumes of gasolene die with symptoms resembling those occurring in man.

Petroleum applied to the skin may induce moderately serious symptoms. A diffuse inflammation of the cutis may occur in severe cases.

When petroleum has been taken internally the symptoms have not always been in proportion to the amount taken. There are two sets of symptoms: (1) gastrointestinal, the kidneys being also involved; and (2) nervous. In the former case there is vomiting as well as the local irritation in the mouth and gullet. Diarrhea, with colic, may supervene. The excreta are covered with oil. In the cerebral form there are headache, anxiety, vertigo, and the pulse is small and infrequent; collapse

and death from failure of respiration and circulation may occur. Tetanic convulsions have been seen. A marked petroleum smell has been noted in the sweat and also in the urine, which may sometimes smell of violets. The urine may also contain albumin and formed elements.

Treatment of Petroleum Poisoning.—Poisonous symptoms from the internal use of petroleum products demand the **evacuation of the stomach** by **siphon** or **emetics**, the exhibition of **stimulants**, and the application of **warmth and stimulants** to the **skin**. **Artificial respiration** may be necessary.

When poisoning follows the inhalation of the fumes, the patient should be removed to the **open air**, or at least to a **well-ventilated room**. **Strong hot tea** and other **stimulants** are indicated, as soon as the patient is able to swallow.

When poisoning occurs by absorption through the skin, the indications are to relieve the dermatitis through the use of **bland, emollient applications**.

THERAPEUTICS.—Internally the crude oil has been given in teaspoonful doses to children suffering with **whooping-cough** and **croup**. In **chronic bronchial disorders** it has been found useful, given internally. Crude petroleum was at one time considered a specific against **phthisis**.

Hutchinson has found that it possesses no value as a food. It is not absorbed, for, after feeding healthy persons with petroleum, he was able in every instance to recover the entire amount from the feces. It is useful, however, as a **protective to the intestinal tract** and as a vehicle for carbolic acid and other anti-fermentatives. As a gastrointestinal protective it may be given in capsules. Petroleum has been given as a vermifuge; 20 to 30 drops three times daily are said to expel **tape-worms**. In **cholera**, refined petroleum has been given with success in doses of 10 to 20 drops in mint-water or white wine.

The inhalation of petroleum vapor has been recommended in **asthma**.

Refined petroleum has been successfully used as a local application to dissolve the false membrane in **diphtheria**. For this purpose, it may also be used as a gargle. Sajous has found it useful in **follicular**

tonsillitis applied with cotton pledget. Petroleum vaporized in the rooms of patients suffering from **diphtheria** has been found beneficial. Petrolatum liquidum is useful in spray, in cases of **acute** and **chronic rhinitis** as an emollient protective.

Petrolatum liquidum is also a desirable lubricant for catheters, bougies, and other instruments. This preparation alone should be used for this purpose, as vesical calculi have been examined which seemed to have as a nucleus a small portion of petroleum jelly.

Petrolatum is useful as a basis for ointments and as an emollient dressing for **sores** and **skin affections**.

Externally refined petroleum, or head-light oil, is used as a counterirritant in **chronic rheumatism**, **synovitis**, **sprains**, **chilblains**, and **paralysis**, and over the throat and chest in **inflammatory disorders of the throat and air-passages**. It is used alone or combined with other drugs in **chronic and parasitic skin diseases**; it has been found beneficial in **psoriasis**, **eczema**, **seborrhea**, **scabies**, **furuncle**, and in **alopecia**. It has also been used externally, in **epithelioma** and **cancer**.

Benzin (gasolene, petrol) is an excellent scalp cleanser, especially when **dandruff** is excessive. It is useful in **alopecia areata**, in **pediculi capitis**, for removing surgical dirt in cases of **scalp wounds**, in **pustular eruptions** about the beard, in **scabies**, **barbers' itch**, in cases of **fissured nipple**, **soft corns**, and **burns**, especially those produced by molten metals. For cleansing and disinfecting the skin previous to operation it is invaluable, being free from irritating properties. Instruments and dressings may be sterilized by benzin.

Rhigolene is a very volatile product of petroleum. So very rapid is its evaporation that a spray of rhigolene will produce a local temperature of 15° F. It should be kept in tightly corked bottles and in a cool place. It is used to produce local anesthesia for minor surgical operations.

Rhigolene is the liquid employed for Paquelin's thermocautery. The use of rhigolene in the vicinity of lights is unsafe. It has also the disadvantage of possessing an unpleasant, garlicky odor.

W.

PHARYNX AND TONSILS, DISEASES OF.—ACUTE TONSILLITIS.—Acute tonsillitis, inflammation of the tonsils and adjacent structures, may be phlegmonous or croupous.

SYMPTOMS.—Acute tonsillitis, often termed quinsy, is ushered in by a feeling of dryness and stiffness in the throat, soon followed by dysphagia. There may be a chill, or chilly sensations, and pain in the legs and back, headache, and fever, which during the height of the disease may reach 106° F. (41.1° C.). As the inflammation progresses, the sufferings of the patient become severe; the dryness of the throat causes frequent attempts at swallowing saliva, which are exceedingly painful. In the phlegmonous variety the mouth can be opened only with pain and difficulty, and speech becomes almost unintelligible. The tongue is heavily coated and the breath fetid. The hearing is frequently obtunded from extension of the inflammatory process to the Eustachian tubes, and abscess of the ear sometimes results. Nasal breathing is at times entirely abolished. The fever, pain, and difficulty of swallowing become greater and greater, if an abscess is forming, and the relief is proportionately great after it has opened. As the patient expectorates the pus, he feels almost well, so great is the sense of relief, the fever and pain quickly subsiding together.

ETIOLOGY AND PATHOLOGY.—An attack of *phlegmonous tonsillitis* is usually the result of exposure to cold and wet; but a person who has once had the affection is more liable to subsequent attacks. Direct infection of a tonsil from

a carious tooth or alveolar abscess has been observed. The rheumatic or gouty diathesis also plays its part in the production of attacks of acute tonsillitis. This is also true of chronic inflammation of the crypts of the tonsils, with accumulation of their secretions. It is by inoculation of the cellular tissue, by such retained and decomposed masses, that peritonsillar abscesses are caused, for abscess rarely occurs within the tonsil itself as the result of acute tonsillitis. Phlegmonous tonsillitis is a disease of adolescence and early adult life, and does not as frequently attack individuals who are over 35 years of age.

Occasionally acute tonsillitis is followed within a month by acute articular rheumatism, and it has been mentioned that the points at which the bacteria causing rheumatism enter the system are the tonsils. However, there are many individuals who pass through a period of their life when they have many attacks of acute tonsillitis not followed by rheumatism, and only after ten or more years, during which they have had no tonsillitis, has the attack occurred. It seems probable that alveolar abscess and carious teeth are more common causes of acute articular rheumatism or tuberculous cervical glands than are the tonsils.

In *croupous* (or *follicular*) *tonsillitis* the brunt of the inflammation is at first borne by the crypts of the tonsils, which pour out an abundant cheesy secretion, which, adhering to the surface of the tonsil, presents somewhat the appearance of a diphtheritic membrane.

Rarely are the lingual and pharyngeal tonsils involved. The disease is

the result of infection, but is contagious only to a very limited degree. It may result from any bacteria capable of producing a croupous pseudomembrane, the most common of such bacteria being the streptococcus and staphylococcus. In typical cases occurring in adults there is usually no difficulty in distinguishing by the unaided eye between the membrane of croupous tonsillitis and the white-gray or grayish-green, but sometimes yellow, and often semi-necrotic membrane of diphtheria. In children diagnosis by the unaided eye is sometimes by no means easy. The struggles of the child may allow only a momentary glance at the parts and bleeding, which always occurs in diphtheria when an effort is made to remove the membrane, may also happen in the croupous tonsillitis of children. However, even in adults, an *absolutely positive diagnosis* between follicular tonsillitis and diphtheria cannot be made without the aid of a competent bacteriologist whose investigations should not only consist of the examination of smears and culture tests, but also inoculation experiments to exclude Hoffmann's bacillus, which resembles, in all respects except virulence, the Klebs-Löffler bacillus.

TREATMENT.—A thorough application of a solution of **nitrate of silver** of the strength of 1 or 2 drams (4 to 8 Gm.) to the fluidounce (30 c.c.) of water frequently aborts the attack, if applied early. The silver solution should be painted upon the tonsils and adjacent inflamed mucous membrane by means of a swab of cotton, and in croupous tonsillitis carried into the crypts after washing them out with **hydrogen dioxide**

by means of a modified Blake cannula. The relief experienced by the patient as the result of the application is almost instantaneous, and the application should be repeated once or twice a day until all inflammatory symptoms have subsided. The nares and pharynx should be washed by means of a spray from an atomizer containing **Dobell's solution** before making these applications, and a lozenge of **guaiaac and tannin** may be prescribed for the patient's use in the intervals between the applications. It is best also to open the patient's bowels thoroughly at the commencement of an attack by means of small, frequently repeated doses of **calomel**. When these measures do not succeed in aborting the attack, and the fever and suffering of the patient are constantly increasing, **aconite**, in drop doses of the tincture every hour or every two hours, will give most excellent results.

When pus has formed, the abscess should be opened by an **incision** through the soft palate just above the upper outer portion of the tonsil, the so-called point of election; or at a spot where the finger detects fluctuation. Even where no pus escapes from the incision, the bleeding affords a certain amount of relief, and may bring about resolution.

CHRONIC FOLLICULAR TONSILLITIS.

This affection is characterized by a feeling of fullness and discomfort in the region of the tonsils. Upon inspection the tonsils are perhaps redder than normal, and many of the crypts are filled with a cheesy exudate (cholesteatoma). The neighboring lymphatics are generally enlarged and tender to the touch.

TREATMENT.—The cheesy exudate should be carefully removed from the crypts, and a solution of **iodine** (Battey's solution) applied to the interior of each crypt by means of a few shreds of absorbent cotton wrapped about the end of a fine probe which is bent to a right angle. Should biweekly applications of iodine in this manner to the interior of the crypts not prove successful, a fine **galvanocautery knife** should be inserted while cold into such of the crypts as resist treatment, and while *in situ* sufficiently heated to destroy the secreting surfaces and burn through the tissues to the surface. In cases where the crypts are very deep, cutting through to the surface of the tonsil is a somewhat painful procedure, and a **tonsil crypt knife** had better be used for the purpose, after which the wound should be seared with the **galvanocautery** to prevent its reuniting during the healing process. The **cheesy secretions** are readily **removed** by means of a suitable syringe. After thoroughly cleansing the crypts, a solution of **iodine** or 10 per cent. **nitrate of silver** may be applied as described above. This treatment is frequently sufficient to prevent the formation of tonsillar concretions or cholesteatoma, and the recurrent attacks of peritonsillar abscess. However, treatment is tedious and the result somewhat uncertain, so that the trend of opinion is toward the complete removal (see **TONSILLECTOMY**) of tonsils with diseased crypts.

HYPERTROPHY OF THE TONSILS.

There are four varieties of chronic hypertrophy of the tonsils: First, the ordinary soft hypertrophy of the ton-

sils found in children and young adults; second, the so-called ragged tonsil; third, the scirrhus or hard tonsil, characterized by an enormous increase of the connective tissue of the gland and a canalicularization of its blood-vessels; fourth, the submerged or buried tonsil, where the hypertrophied tonsil does not project beyond the faucial pillars.

SYMPTOMS.—There is generally more or less obstruction to breathing, the patient snoring during sleep. The articulation is thick and there may be some difficulty in swallowing, especially in the cases of young children. The crypts of the tonsil may become filled with cheesy masses, which, undergoing putrefaction, impart to the breath an offensive odor. Hypertrophied tonsils also sometimes interfere with the proper performance of the functions of the Eustachian tubes and thus are the cause of aural catarrh and deafness.

TREATMENT.—**Tonsillectomy**, **tonsillotomy**, or the treatment of diseased crypts with the **galvanocautery**.

Galvanopuncture is performed in the following manner: A small galvanocautery knife is introduced (cold) into one of the crypts of the tonsil and, being heated while *in situ*, is made to burn its way out. Two or three such burns may be made at a sitting, and will be followed by considerable shrinking of the hypertrophied gland. But one of the tonsils should be operated upon with the galvanocautery at any one time, and five to fifteen such operations are required to reduce the gland to satisfactory dimensions.

Galvanopuncture is useful to destroy any diseased crypts that may remain after tonsillotomy. Some-

times in the case of bleeders and others it is desirable to remove a small tonsil piecemeal. For this purpose a tonsil punch may be used. Such instruments are useful also in removing shreds of tissue that may remain after tonsillectomy.

Tonsillectomy with the tonsillotome is performed as follows: The patient, if a child, should be seated in the lap of an assistant, who holds the child's legs between his own to prevent struggling. The assistant then passes his arms under the child's arms and grasps the child's forehead with his two hands so as to control the movements of the child's head. When the assistant elevates his elbows the child's arms are extended in such a manner as to prevent the child reaching his face with his hands and interfering with the operation.

The tonsillotome is then introduced into the child's mouth flat-wise, like a tongue-depressor, and serves to hold down the root of the tongue and afford a good view of the lower border of the tonsil. The ring of the tonsillotome is now passed around the tonsil from below in order to be sure that the lower border of the tonsil is encircled by the ring, which is pressed firmly against the wall of the pharynx. The blades of the instrument are now closed and tonsillotome and tonsil removed together from the mouth. If the operator is provided with two tonsillotomes it is generally feasible to remove the second tonsil before releasing the child, unless bleeding is so great as to interfere with a view of the fauces.

The operator should be provided with a set of at least three sizes of tonsillotomes, in order that he may

select one with a ring of just sufficient size to snugly fit around the tonsil to be removed. After encircling the tonsil the instrument should be closed somewhat deliberately, and the operator should be careful to make no effort to remove the tonsillotome from the mouth until the tonsil has been completely severed. The operation is not especially painful, and probably causes less discomfort to the patient than the administration of **ether**. However, there is no objection to administering ether for tonsillotomy. Under such circumstances the tonsils are removed with the child lying on its side and its head turned to one side, with the foot of the operating table elevated about three inches.

Tonsillectomy, or the complete removal of the tonsil, in contradistinction to tonsillotomy, or the removal of that portion of the tonsil projecting beyond the pillars of the fauces, is advocated by the larger proportion of laryngologists. Tonsillectomy is always advisable in submerged tonsils and in small tonsils with diseased crypts. Tonsillectomy can be done on docile adults after the injection of local anesthetics into the tissues, about the tonsils, but it is better undertaken under **etherization**. The position of the patient on his side and the elevation of the operating table is the same as for the removal of adenoids.

A mouth-gag is inserted, the tongue is held down and forward with a depressor; mucus and saliva are removed from the pharynx with a gauze sponge; the tonsil is grasped with stout volsellum forceps provided with a catch to render them self-retaining. The upper blade of the in-

strument should be in the supratonsillar fossa and the lower inserted into the lower border of the tonsil in such a manner that a part of the capsule and a considerable portion of the tonsil are included within the grasp of the forceps so that they will not readily tear out. The tonsil is now pulled strongly toward the median line of the pharynx, so that its extent beneath the anterior pillars is readily seen. While traction toward the median line is maintained, the anterior and posterior pillars are dissected loose from the tonsil by means of a tonsil knife, the tonsil being rotated downward and inward out of its bed or pushed or pulled away from the pillars to facilitate the procedure. Especial attention is directed to the attachment of the tonsil to the anterior pillar at the point where the plica triangularis leaves the anterior pillar to extend backward over the lower third of the tonsils. The capsule of the tonsil extends forward and medially to attach itself to the edge of the anterior pillar at this point, and hence, severing this attachment, opens up the space behind the capsule and permits the tonsil to sag outward from its fossa toward the median line of the pharynx. The tonsil is now attached only by its lateral portion to its bed, from which it can be still further separated by the use of the finger-tip inserted into the supratonsillar fossa; better with Hurd's enucleator, a stout steel curette, slightly curved at the tip, which is about the size but much thicker than the forefinger-nail. The loop of a snare is now slipped over the forceps and made to surround the base of the tonsil, which by the use of the enucleator and finger-tip has become pe-

dunculated and adherent only at its inferior portion. As soon as the tonsil is enucleated its fossa should be filled with a small gauze sponge, either held in long, curved tonsillar hemostats or placed in position and firm pressure maintained with the fingers. After a few moments the wound should be inspected. Frequently it will be nearly dry or oozing at only a few points, which can be clamped with tonsillar hemostats or disregarded until the other tonsil has been removed, by which time the wound may have become entirely dry. When the patient is lying on the left side the left or lower tonsil is removed first, then the right or upper tonsil, and finally adenoids if any are present.

The entire operation can be done with forceps and Hurd's enucleator or other similar instrument, or even with forceps and the finger-tips. The objection to this procedure is the unnecessary traumatism and shock occasioned by the rough handling of the parts. It is far preferable to cut the small amount of cellular tissue binding the anterior and posterior pillars to the sides of the tonsils with a sharp, sickle-shaped knife, thus making a smooth cut through the mucous membrane and preserving as much of it as possible. The hemorrhage is so trifling that the parts are easily in view until the base of the tonsil is reached. Then when Hurd's enucleator is pushed underneath the tonsil, it serves to lift the tonsil and prevent the necessity of very hard traction with the forceps. It is sufficiently blunt to prevent much hemorrhage; not more than enough blood to stain a few sponges being usually lost unless the foot of the operating

table is raised sufficiently to cause congestion of the pharynx.

The attachment of the lower pole of the tonsil is often thick and tough, and while it can be torn through with the finger or an enucleator, it is better to cut it with scissors or a snare. For this purpose any snare large enough to carry No. 9 piano wire will answer, and the more *quickly* the loop can be closed the better. Before tightening the loop the parts should be inspected to see that the uvula is not included, which might occur if there is considerable oozing of blood. If there is any difficulty in keeping it out of the way it should be grasped by its tip with a small hemostat, which will effectually prevent its being included in the loop.

Open wounds of the pharynx heal more quickly if let alone; especially when retching, gagging and increased irritation result from medication of the wound. Frequently a superficial slough presents somewhat the appearance of a pseudomembrane; but is without significance as far as healing is concerned. However, cases of sepsis severe enough to endanger life, and thrombosis of the internal jugular extending upward into the cavernous sinus have been reported. The patient should **remain in bed** for a day or so, or until the temperature is normal, and subsist on a **soft diet** until the soreness of the parts subsides sufficiently to permit the swallowing of more solid food. If the wound is not doing well, it may be touched with a 12 per cent. solution of **silver nitrate**, or dusted by means of a powder-blower with a powder of equal parts by weight of **iodoform, tannic acid and bismuth**, which will closely adhere to the wound and re-

main in contact with it for a long time.

Occasionally operations on the tonsil are followed by dangerous hemorrhage. This generally occurs at the time of the operation or some hours after, when the patient is thoroughly recovered from the ether. Before operating the pharynx should be carefully inspected for anomalous arteries and the region of the tonsil palpated to detect any unusual pulsations. Resident physicians in hospitals should be trained in the methods of controlling hemorrhage after tonsil operations, and nurses should be instructed to **inspect** a child from time to time **after a tonsillectomy** to be assured that the child is not swallowing blood; for when hemorrhage occurs some hours after the operation in young children, the blood is usually swallowed; so that the first symptoms of danger may be the vomiting of a large quantity of blood, rapidly followed by collapse. Under such circumstances, a **tonsil clamp** may be useful in controlling the hemorrhage until more effective measures can be instituted. The clamp can be applied either alone or over a gauze sponge inserted into the tonsillar fossa. However, **no clamp** is as effective in controlling hemorrhage **as digital pressure through a gauze sponge** on the bleeding tissues. The pressure should be continued for a few moments, the sponge then gently removed and the parts inspected. It is possible that all parts of the wound will be found apparently oozing blood. Under such circumstances, the **sponge** should be **moistened with hydrogen dioxide**, inserted into the tonsillar fossa and pressure again applied; upon the removal of this sec-

ond sponge, the hemorrhage will be manifestly less, and probably will be controlled by painting the parts with **diluted Monsell's solution**. Possibly one or more points will still continue to bleed and to these the undiluted Monsell's solution should be applied by means of a cotton-tipped applicator held firmly upon the bleeding point. Monsell's solution is an irritant and the undiluted solution should be used with care that no excess of the solution trickles down the pharynx into the larynx. After the oozing of blood from one tonsil is controlled, the other should be treated in the same manner, and if blood is seen flowing from the adenoid wound behind the palate, dilute Monsell's solution should be painted upon this wound also, by means of a bent cotton-tipped applicator.

If the removal of a tonsil is followed by profuse hemorrhage, it should be controlled by inserting one or more **sponges into the tonsillar fossa** and making firm **digital pressure**. After a few moments the sponges are cautiously withdrawn in such a manner that one part after another of the wound is exposed so that any spurting artery can be seized by **long Kocher hemostats** and tied. If at the first attempt the vessel is not seized, a slight twist upon the instrument will probably control the hemorrhage sufficiently to enable the operator to see the bleeding spot more distinctly and clamp it with a second pair of hemostats. Small spurting arteries give no especial trouble except that it is a little more awkward to tie them than in a superficial wound. Occasionally a vessel upon the inner surface of the anterior pillar will bleed in such a manner as

to momentarily confuse the operator; because when the pillar is drawn forward the pressure will be sufficient to control the hemorrhage, which occurs immediately the pillar is released. However, if the anterior edge of the pillar is seized with forceps in such a manner that its cut posterior surface can be inspected, the **bleeding vessel** is easily found and **tied**.

Hemorrhage after the removal of adenoids may be so severe as to require a **postnasal plug of iodoform gauze** in order to control it, which is inserted in the manner already described for the control of nasal hemorrhage.

Occasionally after the removal of adenoids and tonsils patients recover from their ether very unsatisfactorily and for a long time remain nearly pulseless with shallow respiration. The extremities are cold, and the little patient, although conscious, is aroused with difficulty to answer questions. Such symptoms occur sometimes in children who are fairly robust and who have not received an inordinate amount of ether nor lost a large amount of blood at the operation. Fatal cases of this character have been attributed to the presence of a thymus gland that has not undergone spontaneous metamorphosis and partial absorption, the so-called "habitus lymphaticus." It is probable that in some of the fatal cases reported, the element of surgical shock must have played an important rôle; and that it is always safest to subject the tissues of the pharynx to as little rough handling as possible during tonsillectomies; and as little blunt dissection as is compatible with safety from hemorrhage. If during the operation the use of the tongue

depressor caused the patient's respiration to cease, pressure should be relaxed until the respirations become normal. If necessary, the tongue should be drawn out of the mouth with volsellum forceps and pressure applied to only that portion of its base necessary to display the tonsil. In some cases embarrassed respiration becomes very much improved after the removal of the first tonsil. No more ether should be used than is necessary to produce relaxation of the pharyngeal muscles, and it should be remembered that the pharyngeal reflex is one of the last to disappear under ether. There should be no more hemorrhage than is unavoidable, and the surgeon or his assistant should take the time and pains to stop practically all the bleeding after one tonsil is removed, before removing the other. Lowering the head more than is just sufficient to prevent blood gravitating into the larynx or lowering the head by bending the head backward, so greatly increases the congestion of the pharynx that what is gained by decreased probability of blood reaching the larynx is lost by increased congestion. Consequently there is commonly less hemorrhage with the patient lying on one side, as already described, so that blood gravitates into the hollow of the cheek, than when the patient is prone, because there is less necessity for greatly lowering the head.

If in spite of precautions, the little patient is profoundly shocked by the operation, the **foot of the bed** should be **raised** and **oxygen** administered. The heart's action should be maintained by **heat over the heart** and **strychnine**, and blood-pressure increased by the use of 8 ounces (250

c.c.) of normal **salt solution** by **hypodermoclysis** and the institution of **enteroclysis** by the drop method.

Sepsis, severe enough to threaten life, deep cervical cellulitis, resulting in abscess, and thrombosis of the internal jugular extending through the lateral sinus into the cavernous with resulting loss of vision in one or both eyes have been reported. Considering the fact that the mouths of children on whom tonsillotomies are done often contain carious teeth, it is astonishing that such wounds do not oftener become infected. However, it is noticeable that infection most often occurs at the hands of those who are most careful of the after treatment of tonsillectomy wounds, and it is possible that the gagging, retching and consequent irritation of the wound may invite infection rather than tend to prevent it. The author's routine treatment of tonsillectomy wounds consists of inspection for the first three days. His only case of infection occurred in a young woman with a tubercular history who developed a severe cervical adenitis followed by abscess. A slight hemorrhage occurred the night following the operation, which was controlled by digital pressure and some hours later painting the wound with Monsell's solution. She left the hospital on about the fourth day after the operation, remained for a day or two in a house where there was diphtheria, and returned to the hospital with the glands at the angle of the jaw greatly swollen. As there was no pseudomembrane and the diphtheria bacillus was not found, and the tonsillectomy wound on the other side of the pharynx healed without incident, it was thought that the

handling of the wound necessary to control hemorrhage was probably the main cause of the infection.

The lingual tonsil is subject to the same diseases that affect other adenoid structures of the pharynx. Occasionally a venous varix occurs at the base of the tongue on and about the lingual tonsil. If its size is a source of irritation the principal veins should be destroyed with the **galvanocautery**, which, for this purpose, should not be above a dull-red heat, or the vein will be opened and hemorrhage occur. The lingual tonsil becomes sufficiently hypertrophied sometimes to cause irritation and reflex cough. Under such circumstances the **redundant tissue** should be **cut away** by suitably curved scissors with serrated edges to prevent the flabby tissue slipping from the blades. Occasionally a supernumerary thyroid gland or "lingual goiter" is found at the base of the tongue and should not be mistaken for hypertrophied lingual tonsils.

ACUTE PHARYNGITIS.

Acute pharyngitis is an acute inflammation of the mucous membrane and underlying structures of the pharynx.

SYMPTOMS.—The constitutional symptoms are usually trifling: A feeling of lassitude with slight fever; the throat feels sore, dry and stiff. These symptoms increase until the pain, especially when deglutition is attempted, is quite severe. The cervical glands are often swelled and painful to the touch. The voice is generally husky; and a sensation, as of a foreign body in the throat, forces the patient to often hawk and expectorate.

ETIOLOGY AND PATHOLOGY.—Acute pharyngitis is generally the result of exposure to wet and cold, especially in persons suffering from a rheumatic diathesis or from general debility. It may also be caused by traumatism or the presence of a foreign body in the pharynx.

The inflammation is not evenly distributed over the pharyngeal mucous membrane, the glandular elements always being most affected. Their secretion is at first increased, but after a time decreased, becoming starchy and glue-like in character. The tonsils are always involved, the inflammation being sufficiently marked sometimes as to cause them to mask the inflammation of adjacent structures.

TREATMENT.—A **saline cathartic** should be administered in sufficient quantity to secure one or more free movements of the bowels. A 10 per cent. solution of **nitrate of silver** should be painted over the inflamed lateral walls of the pharynx once or twice a day. Care should be exercised not to touch the posterior wall, or the patient's suffering will be increased rather than diminished. On the posterior 10 to 20 per cent. **argyrol** gives better results than silver nitrate. It should be borne in mind that, while the application of a weak solution of nitrate of silver to the inflamed fauces is painful and acts as an irritant, the application of 10 to 20 per cent. solutions is not painful, and is immediately followed by a sensation of relief and comfort, and tends to materially shorten the course of the disease. The application of the silver solution should be followed by spraying the parts with an 8 per cent. solution of **antipyrin**. A

demulcent gargle or **lozenge** should also be prescribed for the patient's use. When acute pharyngitis is due to the presence of a **foreign body**, it should, of course, be at once **removed**, and the inflamed pharynx treated as acute pharyngitis. When the rheumatic diathesis exists, the administration of **guaiac**, either alone or combined with **potassium iodide**, will be found to yield most excellent results, while in gouty sore throat **colchicum** should be prescribed. A spray of **alumnol**, 1 dram (4 Gm.) to 4 fluidounces (125 c.c.) of water used every hour relieves the congestion. When it is inconvenient for the patient to use an atomizer, lozenges may be prescribed. Among the most popular are **chlorate of potash** and **tannin**, **camphor**, **menthol**, and **guaiac** combined with **iodide of potash** or **tannin**.

SIMPLE CHRONIC PHARYNGITIS.

Simple chronic pharyngitis is a chronic inflammation of the mucous membrane of the pharynx generally the result of chronic rhinitis. The disease is often complicated by inflammation of the follicles of the mucous membrane, and is then called "follicular pharyngitis."

TREATMENT.—It is all important to bring about a cure of the nasal disease to the presence of which the pharyngeal malady is due. After the **primary nasal affection** has been **relieved**, simple chronic pharyngitis will often get well almost without treatment. During the treatment of the nasal affection, however, applications should be made to the vault of the pharynx of 8 per cent. **glycerole of tannin**, 1 or 2 per cent. **chloride of zinc**, or a solution containing:

℞ *Iodine* gr. v (0.3 Gm.).
Potassium iodide .. gr. xv (1 Gm.).
Glycerin f℥j (30 c.c.).

A tongue depressor should be used to hold the tongue down, and the patient be requested to try to breathe through his nose in order to relax the palatine muscles. The application may then be made without difficulty by means of an applicator, the end of which has been wrapped with cotton and bent to a suitable curve. Should, however, the palate lie closely in contact with the pharyngeal wall, considerable force will be required to carry the end of the applicator into the postnasal space, while most of the solution with which the cotton on the end of the applicator has been saturated will be squeezed out and remain in the fauces. Applications made in such a manner irritate the parts mechanically and tend to increase the existing inflammation rather than to subdue it; and it is always best to desist from making an application to the pharyngeal vault under such circumstances.

CHRONIC FOLLICULAR PHARYNGITIS.

Chronic follicular pharyngitis, or clergyman's sore throat, is a chronic pharyngitis characterized by inflamed and hypertrophied lymph-follicles.

SYMPTOMS.—The secretions are usually somewhat scanty and viscid, and voided with considerable difficulty. There is a short, frequent cough, distressing alike to patient and friends; the so-called "useless cough," because it accomplishes nothing, either in ridding the throat of secretions or the constant pharyngeal irritation, of which many of these patients complain.

The appearance of the pharynx

varies somewhat; usually there is a venous hyperemia over the entire surface, but greatest in the neighborhood of patches of hyperplastic follicles. In other cases the pharynx is less congested, the hypertrophied follicles projecting above the pharyngeal surface and surrounded by varicosities. Sometimes a number of inflamed follicles coalesce in such a manner as to form a red, sore, and swollen area of considerable size. If such patches be situated close to the posterior pillars, so that they are rubbed and irritated by these folds of mucous membrane with every motion of the pharyngeal muscles, the sufferings of the patient amount to actual pain.

PATHOLOGY.—The pathology is similar to that of simple chronic pharyngitis, only the lymph-follicles are involved in large numbers and to a greater degree. The division into pharyngitis and follicular pharyngitis is a matter of convenience rather than of fact, as in all simple inflammations of the pharynx the mucosa, the lymph-follicles, the submucosa, and often the muscles are usually involved in varying degrees. The watery portions of the secretions are decreased, and hence the expectorations are thick and glue-like from an increased proportion of mucin, epithelial *débris*, and mineral salts.

TREATMENT.—The irritability of the mucous membrane covering areas of hypertrophied follicles can be decreased by lightly painting with a 12 per cent. solution of **nitrate of silver**. However, care should be exercised to prevent the silver solution spreading over the surrounding mucous surface, because strong solutions of silver nitrate are irritating when

applied to the posterior wall of the oropharynx.

A certain amount of relief is experienced by the use of demulcent lozenges, either **slippery elm**, **red gum**, **camphomenthol** or, better still in many instances, a **lozenge of orthoform**.

Where the so-called useless cough is a prominent symptom, it should be controlled by appropriate doses of **sodium bromide**. For this purpose as much as 10 to 15 grains (0.6 to 1 Gm.) after meals and at bedtime will be required. This matter is of considerable importance, as the constant coughing greatly irritates the pharynx and increases the existing inflammation.

With many practitioners the radical destruction of the diseased glands by means of the **galvanocautery** is a favorite method of treatment. A very small cautery knife should be selected, and great care should be exercised not to burn too deeply, or the resulting scar will cause more trouble than the original disease. It is unwise to apply the galvanocautery knife to more than two or three hypertrophied follicles at one time, or the treatment may be followed by a somewhat sharp attack of acute pharyngitis.

ATROPHIC PHARYNGITIS.

Atrophy of the mucous and submucous tissues of the pharynx frequently exists when atrophic rhinitis is present, being probably the result of an extension of the atrophic process to the pharyngeal mucous membrane; or contact with the respired air not properly warmed and moistened by the atrophic nasal mucous membrane, and dry condition of the faucial mucous membrane, amount-

ing almost to pharyngitis sicca, is found in all mouth-breathers, but disappears as soon as the nose has been rendered sufficiently patulous.

The patient complains that his throat feels dry and stiff. Upon inspection, the pharyngeal mucous membrane appears light colored, thin, and as if varnished. The mucous membrane and submucous tissues are so thin sometimes that the outline of each cervical vertebra can be distinguished. Masses of inspissated mucus, perhaps dark colored from the dust inhaled and swept into ridges by the motions of the soft palate, are seen adhering to the surface of the atrophied tissues.

TREATMENT.—Attention should be mainly directed to the condition of the interior of the nose, because when a **cure** of the **nasal affection** has been brought about, the concomitant throat disease will improve almost without treatment. The general health should receive attention; and, if necessary, **tonics** should be prescribed, while constipation should be met by the use of **saline laxatives**. **Iodide** and **bromide of potash** may also be ordered to increase the pharyngeal secretions and diminish reflex symptoms, and a weak solution of **nitrate of silver** (5 to 15 grains—0.3 to 1 Gm.—to the fluidounce—30 c.c.) should be applied to the atrophied mucous membrane, both above and below the soft palate to stimulate the atrophied glands to increased secretion, and bring about renewed growth of the atrophied structures. The patient should use **Dobell's solution** or some other bland **alkaline wash** as a spray through the nose, night and morning, in order to remove adherent secretions.

SYPHILITIC PHARYNGITIS.

SYMPTOMS.—Syphilitic pharyngitis is an inflammation of the pharynx due to the presence of the syphilitic virus, and may be witnessed during both the primary and the secondary stages of the disease. Mucous patches are not rare, whole gummata or their characteristic cicatrices being often met with, especially in dispensary practice. In primary syphilis examination shows a whitish sore, soon followed by swelling of the glands about the angle of the jaw. Secondary lesions may present either the form of mucous patches or erythema characterized by a diffuse redness of the entire fauces; or, in the milder attacks, by a broad red line extending upward upon each of the anterior pillars and ending abruptly and symmetrically at the root of the uvula. The primary lesion is generally on faucial or lingual tonsil. The red lines are almost pathognomonic of syphilis, and persist for a long time after other secondary lesions have disappeared. In secondary syphilis the larynx almost always becomes involved, the voice is hoarse, and there is a short cough of peculiar metallic character, which, once heard and recognized, is rarely forgotten. Mucous patches and erythematous areas in the throat are almost always symmetrical,—that is, both sides of the throat are attacked in corresponding localities by similar lesions,—while tertiary lesions do not so constantly present this symmetry. Gummata more frequently involve the tonsils or soft palate than other parts of the throat. A gumma may be absorbed under treatment, or, breaking down, result in an ulceration. When an ulcerating gumma is situated upon the

posterior wall of the pharynx, the cervical vertebræ, or even the cervical cord itself may finally become involved, and a fatal issue result. In such cases also when the ulceration has involved the posterior surface of the palate, care is required to prevent union of the soft palate and uvula to the pharyngeal wall. Where union has actually taken place, it is difficult at a subsequent period to permanently restore satisfactory communication between the oropharynx and nasopharynx by any operation, because of cicatricial contraction after the operation.

TREATMENT.—In pharyngeal syphilis, as in syphilis elsewhere, constitutional treatment is of primary importance. Especially in primary syphilis, **salvarsan** or **neosalvarsan** should be injected. It is probably possible in primary syphilis, by this method, to bring about a prompt and permanent cure of the disease and even in the secondaries these injections yield quicker results than can be accomplished by mercury. However, relapses are the rule rather than the exception. It is usually better to follow injections of salvarsan by the systematic administration of **mercury**, preferably by inunction or intramuscular injections. In tertiary syphilis, **iodide of potassium** is often as successful in bringing about a disappearance of the characteristic lesions as salvarsan, and the injection should be followed by a course of **iodide of potassium** and **bichloride of mercury** taken at intervals for about three years. Local treatment consists in maintaining **cleanliness** of the diseased parts and stimulating mucous patches and ulcerations to heal by daily applications

of **acid nitrate of mercury** diluted with 6 to 8 parts of water.

HYPERKERATOSIS OR MYCOSIS OF THE PHARYNX.

This is a disease involving in most cases the faucial, pharyngeal, and lingual tonsils, although other parts of the upper respiratory tract do not always escape. It is characterized by little white, conic elevations, sometimes as large as a grain of rice, due to accumulations of horny epithelium extending outward from crypts and follicles with an admixture of bacteria and sometimes fungi of the mycosis class, most frequently the *leptothrix bacillus*.

SYMPTOMS.—A few cones of keratosis may be present in the pharynx without causing any symptoms whatever. Under such circumstances the masses may be discovered incidentally upon the tonsils while examining the throat. Usually, however, patients with mycosis complain of a tickling sensation in the pharynx and spasmodic cough.

TREATMENT.—On the tonsils and other easily accessible portions of the pharynx the little masses should be grasped one by one and pulled off with alligator-forceps or, better, Hartmann's ear forceps. After the **removal of the little masses** the mucous membrane where they grew should be brushed with a 10 per cent. **nitrate of silver** solution. In inaccessible localities, like the base of the tongue and beneath the epiglottis, hyperkeratosis is better attacked with a small **galvanocautery** knife than the forceps.

Some of the cones re-form after their removal. Applications of a 10 per cent. **silver nitrate solution** prevent this to a considerable extent,

and occasionally when applied to the surface where hyperkeratosis exists will cause the cones to disappear after frequent applications. Ultimately the growths disappear spontaneously if untreated, the disease running its course in one or two years.

ERYSIPELAS OF THE PHARYNX.

Erysipelas of the face sometimes extends to the pharynx, or the disease may originate in the pharynx.

ETIOLOGY.—Like erysipelas elsewhere, the disease is the result of the presence of Fehleisen's erysipelas streptococcus.

PATHOLOGY.—The fauces are dusky red and swollen. Vesicles form on the surface filled with seropus. The disease is evidently contagious under certain circumstances, as epidemics have been described, notably that in America in 1842. Erysipelas may extend to the middle ear through the Eustachian tube or to the lungs through the larynx.

PROGNOSIS.—In the milder cases the prognosis is good. The phlegmonous variety of the disease is almost invariably fatal.

TREATMENT.—The treatment is that of erysipelas elsewhere. Large doses of the **tincture of chloride of iron** (20 to 30 drops in water) should be given every three hours, with **strychnine**, $\frac{1}{30}$ grain (0.002 Gm.), if necessary. The nose and pharynx should be sprayed with an **alkaline wash** every three hours, followed by **adrenalin solution** (1:1000). The spray of adrenalin should be repeated at intervals of a few moments until the parts have somewhat blanched, after which they should be covered with a 20 per cent. solution of **argyrol** by means of an atomizer spray.

PHLEGMONOUS PHARYNGITIS.

This is an acute infection of the pharynx phlegmonous in character, extending to the deeper structures, and usually terminating fatally in from five to ten days.

SYMPTOMS.—The onset of the disease is sudden. The temperature rises to 103° or 104° F. (39.4° or 40° C.). The throat is sore and, as in a case observed by the author at the Philadelphia Hospital, the swelling may be so rapid as to necessitate **tracheotomy** within twenty-four hours to prevent suffocation. There are symptoms of general infection; a clammy perspiration, great weakness and debility, often followed by collapse and death.

ETIOLOGY.—The disease usually attacks those of broken-down constitutions or the aged. There is usually a history of slight traumatism, followed by virulent infection.

PATHOLOGY.—There is an enormous swelling of the fauces at an early stage of the disease, followed by a speedy formation of pus, which infiltrates the surrounding tissues and produces pyemia. The organism present in the pus is usually the streptococcus, or there may be a mixed infection.

TREATMENT.—Local treatment is of little avail. If asphyxia is imminent, **tracheotomy** should be resorted to; suspected abscesses should be opened either externally through the skin by a **free incision** or in the pharynx if fluctuation is detected. Hourly hypodermic injections of **anti-streptococcus serum** should be given, with **normal salt solution** by the rectum. **Nutritive enemas** will also be necessary if the patient is unable to

swallow, with hypodermics of **strychnine** ($\frac{1}{30}$ grain—0.0002 Gm.) every three or four hours to prevent collapse.

LUDWIG'S ANGINA.

This was first described by Ludwig, in 1836, as a severe infection, beginning in the submaxillary region, where it soon assumes a character which he termed "gangrenous inflammation of the neck."

SYMPTOMS.—The disease begins as a hard, painful swelling in the submaxillary region, which may run a mild course for days and then suddenly assume an alarming character, because the swelling of the parts interferes with respiration and the swallowing of nourishment. The temperature and pulse are very often comparatively low, but dyspnea may require **tracheotomy** within twenty-four hours of the onset of the disease. In most cases septic intoxication is of less moment as a cause of death than the involvement of the respiratory tract, and death may occur even after tracheotomy from syncope or dyspnea in spite of **artificial respiration** and **oxygen**.

ETIOLOGY.—The etiology of Ludwig's angina so clearly resembles that of phlegmonous pharyngitis that Semon and others have maintained that the diseases were practically identical. There is usually a mixed infection of streptococcus with staphylococci or diplococci.

PATHOLOGY.—The disease is essentially a rapidly spreading cellulitis, beginning in the region of the submaxillary gland from a point of infection, usually a carious tooth, tonsillitis, or an ulcer in the mouth. Fatal results occur from invasion of the larynx, trachea, and the lungs

with general systemic infection, or from suffocation due to pressure by the rapid swelling of the affected tissues. It should be borne in mind that any rapidly spreading cellulitis of the floor of the mouth is a menace to life because the anatomical conditions favor the early involvement of the larynx, and because of the compression of the inflammatory material between the inner sides of the jaw and under the tongue.

TREATMENT.—Early **incision** parallel to the lower border of the jaw over the submaxillary triangle should be done in the expectation of laying bare the focus of infection, which is reached with more certainty in most cases by the safer median incision beneath the chin above the hyoid bone. Incisions on the floor of the mouth are rarely successful in liberating pus.

When an abscess or pus is not found in the submaxillary incision the mylohyoid muscle should be divided and the sublingual cellular tissue exposed. Early incision will probably prevent the irregular septic temperature; profuse sweating and delirium are recorded in some cases. However, after the sublingual tissue has been exposed, should the symptoms indicate, hourly injections of **antistreptococcus serum** with **normal salt solution** by the rectum and stimulants should be given, as in the treatment of phlegmonous pharyngitis.

VINCENT'S ANGINA.

This is an infection of the pharyngeal mucous membrane by characteristic fusiform bacilli and spirochætæ, which are different stages of the same micro-organism.

The disease may be associated with

diphtheria, syphilis, or streptococcus or staphylococcus infection.

SYMPTOMS.—The symptoms are usually those of subacute pharyngitis, unless mixed infection is present. Headache and general malaise, with a temperature up to 102.5° F. (39.2° C.), may be present. The breath is foul, the throat painful when swallowing, and there is generally some swelling of the submaxillary glands.

DIAGNOSIS.—The disease differs from an ordinary acute pharyngitis due to streptococcus or staphylococcus infection in the usually less severe constitutional symptoms, the great tendency to ulcerations, and the presence of characteristic organisms. However, Vincent states that in the diphtheroid form of the disease there is simply a membranous inflammation without ulceration and that only fusiform bacilli can be isolated.

PROGNOSIS.—The prognosis, where no mixed infection is present, is good, the symptoms abating in three or four days, although some redness of the pharyngeal mucous membrane may persist for many days. In cases of mixed infection the severity of the symptoms depends upon the character of the mixed infection.

TREATMENT.—In uncomplicated cases local treatment consists in the application of a solution of **nitrate of silver** (2 to 4 per cent.). The patient should apply to his throat, as a home treatment, the spray from an atomizer containing $\frac{1}{2}$ to 1 per cent. **sulphate of copper**. A mild **quarantine** had perhaps better be observed until the throat clears up. In the more severe forms of mixed infection the internal treatment is similar to that of the phlegmonous pharyngitis.

When pseudomembrane or ulcerations are present, the parts should be cleansed and **Löffler's solution** applied once or twice a day by means of a cotton-tipped applicator. **Neosalvarsan** is useful in all diseases caused by spirilla. The remedy may be injected as in the treatment of syphilis, or a 3 per cent. solution applied to the ulcers and pseudomembrane of severe Vincent's angina.

SIMPLE ULCER OF THE PHARYNX.

Ulcers of the pharynx are localized areas of necrosis.

SYMPTOMS.—The symptoms vary according to the size and location of the ulceration. The pain will be severe, especially during swallowing, if the ulceration is so localized as to be irritated by the action of the faucial muscles. Under such circumstances there may be regurgitation of food through the nose, and if the ulceration is long continued there will be a progressive loss of flesh.

Upon inspection the ulcer is seen upon the pharynx either medianly or laterally, similar in appearance to ulcerations occasionally seen upon the tonsils. It may be round or oblong. The edges are usually well defined and the ulcer may be filled with sloughing tissue, or the floor of the ulcer may be comparatively clean and so deep that, when situated medianly, the bone of the vertebra is bared.

DIAGNOSIS.—The diagnosis in ulceration of the pharynx rests between syphilitic, tuberculous, epitheliomatous, simple ulceration, and Vincent's angina. The Wassermann reaction test or the administration for a week or ten days of 10 to 20 grains

(0.6 to 1.3 Gm.) of iodide of potassium after meals and at bedtime will clear up the diagnosis as far as syphilis is concerned.

Cancer of the pharynx is differentiated by examining microscopically a small section removed from the edge of the ulcer, and tuberculosis by the tuberculin-test, the condition of the patient, and by microscopic examination of the sputum.

ETIOLOGY.—Most ulcers of the pharynx are due to syphilis, epithelioma, or tuberculosis. However, there is an ulceration of the pharynx or fauces, generally the result of mixed infection, that is occasionally observed. Some cases are the result of traumatism followed by infection.

TREATMENT.—The treatment of syphilitic, epitheliomatous, and tuberculous ulcerations has been described elsewhere. In simple ulceration, tonics and 10 to 15 grains (0.6 to 1 Gm.) of **pepsin** after meals should be given. The ulcer should be cleansed each day with **Dobell's solution** or **hydrogen dioxide**, and an application made of a solution of **nitrate of silver** (15 per cent.), after which the floor of the ulcer should be dusted either with **orthoform** or a mixture of equal parts by weight of **iodoform**, **tannic acid**, and **bismuth**. Both orthoform and the above powder are analgesic and relieve pain. They are also antiseptic and adhere to the ulcerated surface, sometimes for hours. Of the two, the iodoform and tannic acid powder gives the better results.

LEPROUS PHARYNGITIS.

According to Hollmann, leprosy of the pharynx begins by the formation of small tubercles, which break down, forming ulcerations which finally

penetrate the soft palate, so that in some instances the perforations are so numerous that the palate resembles a sieve. Similar ulcerations occur on the pharyngeal wall and the tonsils. In some cases a small ulcer may assume a gangrenous character, associated with marked systemic toxemia. Under these circumstances, treatment consists in the injection here and there into the gangrenous ulceration of a few drops of a 5 per cent. solution of **zinc chloride**, which in a day or two causes a slough which, when detached, exposes clean, healthy tissue.

The tonsils frequently are the seat of leprous tubercles and become greatly hypertrophied, with subsequent fibroid changes.

TUBERCULOSIS.

The presence of the tubercle bacilli is sometimes demonstrable, by means of the microscope, in the secretions of a mild chronic pharyngitis of nurses and attendants in the tuberculosis wards of hospitals. Primary tuberculous pharyngitis with marked lesions is rare. Secondary tuberculous pharyngitis in phthisic patients is somewhat common, and is usually observed as ulcerations resembling those of tertiary syphilis.

Infection probably reaches the pharynx through some localized solution of continuity from the secretion of the tuberculous lungs. Tubercles form in the submucosa, which finally break down and ulcerate.

TREATMENT.—In cases where there are no marked lung lesions and the diagnosis is obscure, the Wassermann reaction test or antisiphilitic remedies should be administered until the surgeon has satisfied himself that the disease is not syphilis.

When ulceration has occurred the ulcers should be cleansed with **hydrogen dioxide, cocainized**, and touched with **lactic acid** once in two or three days. As these applications are somewhat painful, even after cocainization, it is well not to employ a stronger solution than 25 per cent. until the amount of pain and reaction caused by the application has been ascertained, after which the concentrated syrupy acid may be employed if deemed advisable. Rarely is it necessary to employ the **curette**, and the prognosis as regards healing is favorable.

LUPUS VULGARIS.

This is a form of inflammation involving the mucous membrane and submucous tissues of the pharynx, generally ending in ulceration due to the presence of the tubercle bacilli.

SYMPTOMS.—The general condition of the patient may be that of good health. The disease is insidious and causes little annoyance until the ulcers are sufficiently large to interfere with the functions of the parts. Early in the disease soft, reddish nodules about the size of sago grains appear on one or both sides of the pharynx. These finally break down, producing ulcers which may spread to the pillars of the fauces, the palate, or the larynx, one portion of the ulceration healing while another is extending.

DIAGNOSIS.—The ulcerative stage may be mistaken for herpes, syphilis, or epithelioma. The short duration of herpes and the more rapid progress of epithelioma should serve to differentiate the diseases from lupus. In suspected syphilis the Wassermann reaction or the "therapeutic test" with iodide of potassium

serves to clear up the diagnosis. The tuberculin test gives a positive reaction, causing local hyperemia and some rise of temperature, which subsides in twenty-four hours. The microscope shows typical tubercle giant cells.

ETIOLOGY.—The disease is said to be more common on the continent of Europe than in America. It occurs in tuberculous families and in those frequently brought in contact with tuberculous patients.

PATHOLOGY.—Portions of the diseased tissue curetted away show, under the microscope, typical giant cells. However, tubercle bacilli are found only in small numbers and with difficulty.

TREATMENT.—The parts should be thoroughly **curetted** and the **solid stick of nitrate of silver** applied. Cures have been reported by the use of the **X-ray**.

ACTINOMYCOSIS.

This is a parasitic, infectious, inoculable disease, first observed in cattle and later in man. It is due to the presence of the leptothrix, streptothrix, or ray-fungus. The most frequent and curable form of the disease is when abscesses form about the jaws or fauces. When the parasite has found a nidus in the lungs or digestive tract the disease generally proves fatal.

SYMPTOMS.—The symptoms and pathology of the disease, as affecting the human tonsils, were first described by Jonathan Wright (1904). The symptoms are those of granulating, painless abscess with general systemic infection. The laryngologist is usually first consulted by the patient for catarrh and hypertrophied tonsils. One or more crypts of the

tonsils may be suppurating and lined with granulations.

ETIOLOGY.—Actinomycosis is the result of inoculation with the ray-fungus, which gains entrance to the mouth, pharynx, or nose from ingesta or inspired air. The disease may originate primarily in either of these cavities and, more rarely, in the larynx or ear.

PATHOLOGY.—A slow swelling occurs, usually first at the angle of the jaw, which renders swallowing difficult. Upon inspection, if supuration has not already occurred, the mass will be found to be firm to the touch and involve one or more of the cervical glands or the tonsils. At the seat of infection a nodule occurs which breaks down and discharges pus containing typical granular masses, which, upon compression, form star-like bodies, yellowish in color, with a center which stains blue with Mallory's stain.

TREATMENT.—The affected tonsil or tonsils should be **amputated**. Where this cannot be done, the application of the **galvanocautery** is the best form of treatment. Each **nodule** or **suppurating crypt** should be thoroughly **destroyed**. **Abscesses** occurring in localities other than the tonsils should be **opened**, **curetted**, and **cauterized** with the **solid stick of nitrate of silver**. **Iodide of potassium** in large doses is stated to inhibit the growth of the ray-fungus, and Sawyer reports favorable results from the injection into tumors of from 15 to 30 minims (0.9 to 1.8 c.c.) of a 1 per cent. solution of the **iodide**.

RETROPHARYNGEAL ABSCESS.

An abscess of the posterior pharyngeal wall may be hidden above and

behind the soft palate, and require the rhinoscope to ascertain its outline; it may be situated opposite the larynx and only be partly visible with the laryngoscope; or it may be situated in such a manner as to be hidden by one of the posterior pillars of the pharynx. However, the most common seat of abscesses is the posterior wall of the pharynx opposite the oral cavity.

It may occur as the result of phlegmonous inflammation of the cellular tissue of the pharynx, or from the breaking down of an inflamed lymphatic gland. Caries and necrosis of the vertebræ or temporal bone are occasionally causes of the affection.

There is usually but slight systemic disturbance. Local symptoms are usually the first to attract attention, especially in infants, among whom the disease is more common. When the abscess is situated high up upon the pharyngeal wall, a sensation suggesting the presence of a foreign body causes almost constant hawking and spitting, while there may be present obstructed nasal respiration with more or less pain and tinnitus. When the abscess is opposite the larynx, dyspnea is a marked symptom, appearing in "spasms," which may endanger the patient's life, while swallowing of liquids or solids is dangerous, owing to their passage into the larynx. An abscess in the pharyngeal wall opposite the oral cavity presents none of these symptoms unless it is very large.

PROGNOSIS.—The prognosis is favorable except in those cases where the spinal vertebræ are involved. In all operations upon the posterior wall of the pharynx it should be borne in

mind that a large artery is occasionally found in this position, probably the vertebral, which sometimes enters its osseofibrous canal as high up as the fourth or even second vertebra. It has been seen to leave its canal at the third vertebra, to re-enter it at the atlas.

TREATMENT.—Left to itself, a retropharyngeal abscess will discharge either into the throat or at some remote point, but it should be opened as soon as a diagnosis is made, by means of a curved small trocar and cannula. Should the pus recur, an incision should be made into the abscess at its lowest part, and the opening maintained patulous by the daily passage of a probe.

The author has several times opened a retropharyngeal abscess without general anesthesia, with the child in an upright position. However, it is probably better to place the patient on his side, with the foot of the operating table elevated as for a tonsillectomy. The abscess is then located with the forefinger-tip, which serves as a guide for a long-handled knife, and the abscess incised, washed out with boric acid solution, and iodoform emulsion in glycerin injected. When the abscess is complicated by caries of the vertebræ it is better opened through the skin by the external route. An incision two or three inches long is made on a plane with the abscess, parallel to the anterior border of the sternocleidomastoid muscle. The deep cervical fascia is opened and the anterior border of the sternocleidomastoid muscle exposed and drawn forward. By blunt dissection the carotid sheath, with its vessels and nerves, is separated from the vertebræ and drawn

forward and the dissection carried in front of the vertebræ to the abscess wall, which is punctured and a closed hemostat inserted and withdrawn opened. The cavity is then explored by the finger for necrosed bone and a drainage-tube inserted. Aneurism has been mistaken for retropharyngeal abscess with fatal results following incision, so that it is important to arrive at a correct diagnosis before operating.

FOREIGN BODIES IN THE PHARYNX.

This subject has been in part reviewed in the article on the ESOPHAGUS (volume v), the majority of foreign bodies which enter the pharynx being, in reality, impacted in the upper portion of the former, either behind the larynx or on either side of the latter, in one of the pyriform sinuses, or above the epiglottis. When, therefore, foreign bodies of the pharynx are spoken of and the limits of this cavity are properly established, the scope of the subject becomes restricted. Indeed, unless it be a sharp object capable of sufficiently lacerating the upright posterior pharyngeal wall to hold on to it, a foreign body will either pass below to the esophagus as stated, or into the larynx, or lodge behind one of the pillars or into the tonsils. Strictly speaking, the latter are the seat of almost all foreign bodies which can be said to have become impacted in the pharynx. These are almost always sharp objects,—fishbones, tacks, pins, etc.,—capable of easily penetrating the tonsillar crypts or between the pillars, or in the recess behind the posterior pillar.

Foreign bodies are often referred to as still present in the pharynx

when, in reality, they have passed downward. This is usually due to the presence of a minute abrasion or scratch produced by the foreign body on its way downward. Again, hysterical subjects seem to present a predilection for pharyngeal foreign bodies, and in the majority of cases of this kind a foreign body has not been swallowed at all.

SENSORY PHARYNGEAL NEUROSES.

ANESTHESIA occurs as a symptom of various disorders in which the general nutrition is impaired, especially anemia and phthisis, and of cerebral disorders: apoplexy, general paralysis, tumors, etc. Some drugs—the bromides—induce sufficient anesthesia of the pharynx to facilitate local operations in this region. Certain neuroses—epilepsy, hysteria, and chorea—are also attended by more or less pharyngeal anesthesia.

HYPERESTHESIA.—Hyperesthesia is usually observed in individuals whose pharynges are kept in a congested state through unhygienic habits, local disease, etc. Thus, drunkards almost invariably have very sensitive pharynges, while tonsillitis and pharyngitis, and certain gastric and hepatic disorders tend to cause hyperesthesia through engorgement of the vascular system, etc. Pharyngitis sicca is frequently attended by marked hyperesthesia.

PARESTHESIA.—Abnormal sensations in the pharynx, heat, cold, the presence of a foreign body, enlargement, "tickling," and particularly the painful sensation that a scratch produces are commonly observed. While occasionally these subjective symptoms represent but

hallucinations of sensation, a cause can usually be detected when a sufficiently careful search is instituted. A sensation suggesting the presence of a foreign body, for instance, is frequently due to an almost imperceptible laceration or abrasion of the mucous membrane caused by a spicule of bone, a small piece of crust, a seed, etc. Inflammatory tonsillar disorders of almost any kind may also act as etiological factors; the lingual tonsils or mass of lymphoid tissue at the base of the tongue when enlarged being especially active in this particular. Among the general diseases capable of acting as sources of this disorder are the menopause, the rheumatic and gouty diatheses, hysteria, and neurasthenia; among the local causes, elongation of the uvula, nasopharyngeal catarrh, and pharyngitis sicca.

TREATMENT.—In all these manifestations the **cause** should be sought after and **corrected** and the pharyngeal **surfaces treated** according to the character of the lesion noted.

PARALYSIS OF THE PHARYNX.

ETIOLOGY.—Paralysis of the pharynx is usually caused by diphtheria, syphilis, or cerebral affections implicating the nerves which supply the pharynx. It is sometimes caused by local inflammation, especially when this is membranous. The paralysis may be limited to one constrictor muscle, or involve them all; it is an occasional complication of hemiplegia. It frequently occurs as a precursor of death in febrile diseases, especially typhus and pneumonia.

SYMPTOMS.—Besides nasal speech there is difficulty of deglutition, great effort being required to

force the food down the esophagus. Liquids are generally swallowed with less difficulty, but their frequent passage into the larynx renders their use dangerous. When the soft palate is involved, the food may be forced into the posterior nasal cavity, through the efforts of the tongue to assist deglutition. The accumulation of mucus on the pharyngeal wall is very troublesome.

TREATMENT.—Besides treatment of the central cause, strychnine hypodermically and general tonics are almost always indicated. Arsenic is especially valuable when the affection is a sequel to diphtheria. Electricity serves the double purpose of assisting in the diagnosis and restoring motion. When the paralysis is of central origin, an interrupted current will cause contraction of the muscles, but this contraction will not occur if atrophy of the muscles is the principal pathological element of the case; the cure will then be rendered much more difficult, if at all possible. Therapeutically, electricity should be applied with both electrodes over the muscles for about ten minutes every other day.

TUMORS.

Any of the varieties of tumor found in other parts of the body may occur in the pharynx. They are most frequently located in the lateral walls and may involve the surrounding structures. In the following order of frequency are found in the pharynx: Gumma, sarcoma, carcinoma, lupus, papilloma, cysts, fibroma, osteoma, enchondroma, adenoma, and aneurisms.

When the growth is large it may become an obstruction to deglutition or even respiration. In carcinoma

and ulcerating growths, pain is present, usually radiating into the ear.

TREATMENT.—Early extirpation with the knife, galvanocautery, or snare should be practised in suitable cases.

DISEASES OF THE UVULA.

INFLAMMATION OF THE UVULA may occur primarily or as the result of extension of inflammation from the tonsils or palate.

Occasionally the uvula becomes edematous and distended. The distention may be so great as to produce dyspnea. The treatment consists in cocainizing the uvula, seizing it with a pair of mouse-tooth forceps, and freely incising the mucous membrane in a number of places in order to allow the fluid to escape. The same object may be accomplished sometimes more conveniently by snipping off the mucous membrane at the tip of the uvula.

Pseudomembranous Uvulitis.—The extension of a pseudomembrane from the tonsils to the uvula is somewhat characteristic of diphtheria. However, this occurs in other forms of pseudomembranous pharyngitis.

Treatment of Inflammation of the Uvula.—As inflammation of the uvula generally is only a part of an inflammation involving the rest of the fauces, it is best to begin treatment by spraying the fauces with a 1:10,000 solution of adrenalin; the uvula should then be painted with a 10 per cent. solution of nitrate of silver. This should be done in the physician's office once or twice a day, the patient in the intervals either spraying his fauces every two or three hours with a 1:10,000 solution of adrenalin or a 3 per cent. solution of alumnol.

ULCERATION OF THE UVULA.—The uvula sometimes becomes ulcerated as the result of traumatism and infection. Syphilis, lupus, or tuberculosis may be primarily located in the uvula. The uvula is sometimes destroyed by an ulcerating gumma. Occasionally these cases are first seen by the laryngologist when the ulcer has made considerable progress and the uvula hangs, as it were, by a shred of mucous membrane. Under these circumstances the uvula sometimes can be saved by the daily **subcutaneous injection of mercury**, which probably yields quicker results than other methods of treatment. Where an increasing gumma involves the posterior wall of the pharynx as well as the uvula and soft palate, there is great danger of cicatricial adhesions occurring that may entirely shut off communication between the posterior nares and the oropharynx.

DEFORMITIES OF THE UVULA.—**Bifid Uvula.**—The uvula when present is always bifid in cleft palate as the result of the same cause that produces the palate deformity. Hence, ordinary bifid uvula might be considered as an incomplete cleft palate. The deformity varies from a little dent at the free extremity of the uvula, which is usually club shaped, to a complete division separating the uvula into two lateral halves.

Treatment.—Bifid uvula, when it causes no symptoms, is best let alone. However, the parts may be **freshened** by means of a **V-shaped incision and sewed together**. If the uvula is thoroughly **cocainized** and then sprayed with **adrenalin**, the operation is both painless and blood-

less. For anesthetizing the uvula, simply painting the parts with a 10 per cent. solution of **cocaine** is not sufficient. The operator should be provided with a small cup at the end of a long handle. This is partly filled with a 4 per cent. solution of cocaine, and held under the palate in such a manner that the uvula soaks in the cocaine solution for a few moments before the operation.

ELONGATION OF THE UVULA.—The whole mass of the uvula may be hypertrophied. More frequently, however, merely the mucous membrane is relaxed and hangs as a conical tip below the uvula proper. In rare cases a warty growth is attached to the end of the elongated uvula.

Symptoms.—Patients complain of a “tickling in their throats.” The elongated uvula hanging in contact with the base of the tongue causes an almost constant short cough as an effort to dislodge a supposed foreign substance. These efforts are sometimes persisted in until nausea and vomiting result. Snoring is usually marked and the sleep is disturbed by dreams.

Etiology.—It is generally the result of chronic pharyngitis, the constant hawking to dislodge masses of mucus from the pharynx having a tendency to cause the affection. Paralysis of the palate is a reflex sometimes observed in ethmoiditis, and in such cases paralysis of the azygos uvulæ muscles and consequent elongation of the uvula are concomitant with the affection.

Treatment.—The redundant portion of the uvula should be amputated. This is ordinarily only relaxed and redundant mucous membrane at

the tip of the uvula. It is rarely or never necessary to remove any of the muscular structure of the organ, and **amputation** of the entire uvula close up to the soft palate is done only for the removal of malignant disease, or as the result of ignorance or awkwardness of the operator. The operation is perhaps best done in the following manner: The uvula is grasped at a point just below where it is decided to amputate, with a pair of long hemostats, which are then clamped. The position of the hemostat marks the spot on the uvula where it has been decided to amputate, so that there is no danger of cutting off too much or too little. The uvula is stretched well forward and cut off close to the forceps by a single cut of a pair of somewhat heavy scissors, curved upon the flat, and held with their concavity upward in such a manner that the uvula is cut somewhat obliquely upward; and the wound, being upon the posterior surface, is protected from contact with food during the healing process. Generally there is but little inflammatory reaction and the wound heals promptly, but occasionally a mild acute pharyngitis occurs as the result of the operation when the uvula is thick and fleshy.

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PHENACETIN. See ACETPHENETIDIN.

PHENIC ACID. See PHENOL, OR CARBOLIC ACID, AND DERIVATIVES.

PHENOCOLL.—Phenocoll, or amido-acetphenetidin, is a derivative of phenacetin, produced by the action of glycocoll, which is an amido-acetic acid, upon phenacetin. It occurs in white, matted needles, soluble in alcohol and slightly soluble in water. Several salts of phen-

ocoll are in use: the hydrochloride, salicylate, acetate, and carbonate. The hydrochloride is most frequently used; it occurs in colorless needles or as a white powder, having a salty taste, with a sweetish after-taste and an aromatic odor, and is soluble in 16 parts of water, forming a neutral solution. It is incompatible with the alkalies. Its chief use is as an antipyretic, although it is also an antirheumatic, analgesic, and diaphoretic. It is best given in powder, mixed with sugar, as the aqueous solution, neutral at first, develops an alkaline reaction after two days.

Phenocoll salicylate, or salocoll, occurs in fine needles having a sweetish taste, and is soluble in hot water. It has antipyretic, antiseptic, and analgesic properties, is well borne by the stomach; does not produce pain in the stomach, modification of the blood-pressure, nor cyanosis; and has, apparently, no depressant effect upon the heart. It is used in the same dose and for the same purposes as phenocoll.

Phenocoll acetate (soluble in $3\frac{1}{2}$ parts of water) and phenocoll carbonate have also been prepared.

Dose.—Any of these preparations may be given in doses of from 10 to 15 grains. The maximum daily dose is 75 grains.

PHYSIOLOGICAL ACTION.—Phenocoll is rapidly eliminated; it may be found sometimes as soon as an hour after ingestion in the urine, and gives it a reddish-brown color. Balzer ascribed to phenocoll the power of markedly increasing nitrogenous elimination; but this is doubtful. Ott found that it produced paralysis of both motor and sensory functions of the spinal cord, death being due to diastolic arrest of cardiac action. Cerna and Carter, in a series of careful experiments, thus summarized the physiological effects of this drug: 1. Phenocoll, in ordinary amounts, has practically no effect upon the circulation. 2. Large doses diminish the blood-pressure by influencing the heart. 3. Phenocoll reduces the pulse rate by stimulating the cardio-inhibitory centers. It then increases the rapidity of the pulse by paralyzing said centers. The final diminution is of cardiac origin. 4. Upon the blood itself phenocoll has no action.

They have also shown that the very decided fall of temperature, which occurs the first hour after the administration of the drug by the stomach, is the result of an enormous diminution of heat production, without any alteration of heat dissipation; hence great care should be exercised in all diseases in which the vital powers are low.

THERAPEUTICS.—Phenocoll has been given in **fevers** in the same manner as phenacetin; but, like phenacetin, it is contraindicated in advanced exhausting diseases. If too much diaphoresis is induced it may be controlled by the use of atropine. Phenocoll hydrochloride has been found useful in **acute rheumatism, influenza, pertussis, chorea, malaria,** and in **neuralgias** of various kinds.

In **malarial fevers** 15 grains are given from two to six hours before the expected paroxysm. It may be combined with quinine.

Phenocoll may be used externally as a dressing for **traumatic** and **operative wounds**, and for **inflamed** and **suppurating cases** in the forms of a 10 per cent. gauze, a 5 per cent. watery solution, and a 10 or 15 per cent. alcoholic solution. As a dressing for **burns** and **ulcers**, a 10 or 20 per cent. ointment may be used, but the gauze gives better results. Phenocoll is inodorous and devoid of all irritating properties. W.

PHENOL, OR CARBOLIC ACID AND DERIVATIVES.—

Phenol, phenylic or phenic acid, carbolic acid (phenol, U. S. P.), hydroxybenzene, phenylhydrate, phenylic alcohol, or coal-tar creosote is obtained by fractional distillation, at 338° to 446° F. (170° to 230° C.). Pure phenol (phenol, U. S. P.) occurs in long, colorless needles, melting at 95° F. (35° C.) and having a characteristic odor and, when highly diluted, a sweetish taste. Phenol deliquesces in moist air and becomes red on exposure to the light. It is freely soluble in alcohol, ether, chloroform, and glycerin, and slightly solu-

ble in water. It is extracted from watery solutions by animal charcoal, which suggests the use of the latter as an antidote (Lubenetzky). The Pharmacopœia of 1890 recognized a crude acid (acidum carbolicum crudum, U. S. P.), which is a mixture chiefly of cresol and phenol and occurs as a dark, oily liquid, having a strong tar odor, and is partly soluble in water. This crude phenol is used chiefly for disinfecting purposes either in solution (1 in 50 to 200) or mixed with chloride of lime, slaked lime, etc.; the crude acid is not adapted for wounds.

Between the above official preparations there are others of various grades of purity. Five grades, known by numbers, are made. The pure phenol in colorless crystals is known as number one, and is alone fit for internal use. Number two is also crystalline. Numbers three, four, and five are impure, containing other ingredients of coal-tar, especially cresol.

The crystals of pure phenol may be liquefied by the addition of 5 per cent. of water, a clear solution resulting; the further addition of water produces turbidity until the proportions are reversed (1 to 20), when it becomes permanently clear and remains unaffected by further dilution.

PREPARATIONS AND DOSES.

—The official preparations are:—

Phenol, U. S. P. (pure crystals). Dose, 1 to 3 grains (0.05 to 0.15 Gm.).

Phenol liquefactum, U. S. P. (liquefied phenol, 87 per cent. absolute phenol and 13 per cent. water—both by weight). Dose, 1 to 3 minims (0.05 to 0.15 c.c.).

Glyceritum phenolis, U. S. P. (glycerite, 20 per cent.). Dose, 5 minims (0.3 c.c.).

Unguentum phenolis, U. S. P. (ointment, 2.25 per cent. liquefied phenol).

Among the used unofficial preparations are:—

Phenol iodatum, N. F. (iodized carbolic acid, iodized phenol, acidum carbolicum iodatum,—containing iodine, 20; phenol, 60; glycerin, 20 parts). Used externally as a counterirritant and cauterant.

Liquor sodii boratis compositus, N. F. (Dobell's solution, containing sodium borate and bicarbonate, each 1.5; phenol, 0.3; glycerin, 3.5; sterilized water, ad 100 parts). Alkaline, antiseptic solution, used where phenol is not contraindicated.

Liquor sodii carbolatus, N. F. III (caustic soda, 3.5; phenol, 50; water, ad 100 parts). Deodorant and disinfectant.

PHYSIOLOGICAL ACTION.—

Locally, phenol is an energetic caustic, in dilute solution an irritant. In concentrated form, when brought in contact with the tissues, it causes a burning sensation, quickly followed by numbness (from paralysis of the peripheral sensory nerves), blanching of the area, rapid disorganization of the part and the formation of a hard mass, which does not disappear for some time, and if left on too long may produce gangrene. Many cases of gangrene have been reported, especially where phenol was applied to the broken skin, which suggests the thought that, as it has real penetrating power through unbroken skin, it should never be covered with any material that will prevent evaporation, but should be applied only with a light dressing (Levin). If one of the extremities be immersed in a comparatively weak solution of the drug, a contraction of the capillaries and

consequent pallor of the skin result, with a certain amount of local anesthesia. Upon the mucous membrane the acid causes, first, a sensation of burning pain, then anesthesia, leaving a white eschar (Pouchet).

When administered internally in toxic doses it gives rise to convulsions of spinal origin, to which are added at first increased reflex activity. This being followed by paralysis, it is evident the spinal centers are first stimulated, then depressed. The nerves and muscles, as shown by Salkowski and Hoppe-Seyler, are not distinctly paralyzed, however, since they respond actively to galvanic stimulation (Wood). The arterial pressure is reduced and the heart depressed. Gies has shown that phenol paralyzes the vasomotor center in the medulla before affecting the heart. The condition of the blood induced in animals is one of oligocythemia rather than oligochromemia, as the reduction of blood-corpuscles is not accompanied by any alteration in the percentage of hemoglobin (W. J. Wilkinson). Respiration is at first greatly increased in frequency, owing, mainly, to a stimulating influence exerted upon the respiratory centers during the first stages and in part to stimulation of the peripheral vagi (Salkowski). As to the effects on temperature, H. C. Wood concludes, from the experiments of H. A. Hare and E. Erls, that phenol may affect the thermogenic functions in two ways: first, by diminishing the production of heat; second, by increasing the dissipation of heat.

From careful and extended experiments, Sollmann, Pilcher, and others find that when phenol enters the alimentary canal its absorption is at

first very rapid, but is quickly checked and soon practically arrested. This inhibitory effect on phenol absorption is apparently not due to its toxic action on the epithelium, but to a specific slowing of the intestinal circulation.

Phenol coagulates albumin, and in sufficiently strong solution is poisonous to all forms of life, its main use in practice depending upon its ability to destroy micro-organisms rather than as a stimulant. Phenol is excreted by the kidneys, and gives rise to dark, smoky urine, and at times suppression of the urine.

POISONING BY PHENOL (CARBOLIC ACID).—Phenol is a most deadly poison and acts rapidly. Six or seven drops have caused the most dangerous symptoms. Death may be expected to follow almost immediately after taking any large quantity. Death has taken place within ten minutes after swallowing about 1 ounce (30 c.c.) of phenol, although life may be protracted two or three days. If a large dose be swallowed one may drop dead before he can get more than a few feet from the spot where he stood or he may live a few hours. Sudden death is due to failure of respiration. If death is delayed, symptoms of violent gastroenteritis ensue.

SYMPTOMS.—The symptoms of poisoning are vertigo and intoxication, accompanied with vomiting of frothy mucus, and an intense burning pain in the mouth, esophagus, and stomach. The pupils are contracted, the pulse rapid and intermittent, and coma, collapse, or convulsions ensue. The skin is covered with a clammy sweat, the features are pinched and anxious, and the

pulse becomes very thready and almost imperceptible, as a rule. White eschars are noticed about the mouth if the pure acid has been taken, or blackish if the impure drug has been used. The odor is apt to hang about the person or clothes. The urine is frequently suppressed, but, if passed or withdrawn by catheter, is dark colored and smoky. Convulsions or coma often close the scene. A very common symptom is hoarseness of the voice, and is due to an effect on the larynx after the drug is absorbed, and not from its local influence.

Cases are on record in which phenol poisoning has been due to its absorption from surgical dressings. In these cases a darkened, smoky hue of the urine, with slight nervous unrest or cerebral disturbances, is present. Pain in the lumbar region is another indication of this condition, and should suggest the removal of the dressings.

Autopsies in cases of phenol poisoning will show the tongue, gums, and, in fact, the whole mouth are colored white. This discoloration also affects the whole alimentary tract. The mucosa of the esophagus is smooth and white and can be easily stripped from the muscularis. The kidneys show either intestinal changes or else the parenchyma of the organ is mainly involved. In most of the cases the lungs are congested and edematous. The remaining internal organs present no lesion which can be ascribed to the acid.

Von Bruns states that carbolic acid in concentrated solution is relatively less toxic than when diluted, its penetrability during its brief influence is but slight, and the bactericidal action

of pure carbolie acid surpasses that of sublimate in albuminous compounds.

Treatment of Poisoning by Phenol (Carbolic Acid).—When phenol accidentally comes in contact with the skin, wash it off quickly with **alcohol**, **whisky** or **vinegar**, and apply **tincture of iodine** to check its action (a minim of tincture of iodine will neutralize the same amount of liquid phenol in a test-tube, forming the non-toxic phenol iodide).

When taken internally, in the absence of excessive damage to the mucosa of the stomach, the stomach should be washed out with 50 per cent. **alcohol**, **whisky**, or other alcoholic solution until it is freed of the phenol, and then with pure water; if no **stomach-tube** is at hand give 5 or 6 drops of a 2 per cent. solution of **apomorphine hydrochloride**.

To antidote any residual poison give **whisky**, **brandy**, **gin**, or **rum**, or an equivalent of **diluted alcohol**, freely, to lessen the escharotic action of the phenol, and as a stimulant. If these are not at hand, give **vinegar**, **dilute acetic acid**, or **egg-albumin**. **Tincture of iodine** in doses of 5 to 20 minims (0.3 to 1.3 c.c.) every four hours is an effective antidote.

To eliminate the poison from the digestive tract and from the blood, give **sodium sulphate** (Glauber's salt), **Epsom salt**, or other **soluble sulphate** well diluted.

Apply **warmth** and **friction** to the **extremities**. Give **flaxseed-** or **slippery elm-** tea, or gruel to protect the mucosa. Give as a stimulant, to relieve shock, hypodermic injections of **digitalin** and **strychnine**, and support respiration and circulation with hypodermics of **atropine sulphate**, $\frac{1}{100}$ gr. (0.0006 Gm.), **adrenalin hydrochloride**, $\frac{1}{1000}$ gr. (0.00006 Gm.), or **camphor** (sterile saturated solution in oil), 30 minims (2 c.c.) every half-hour, and **amyl-nitrite** inhalations.

Pain may be relieved by injections of **morphine** and **counterirritation** over the abdomen. Emetics usually will not act on account of the condition of the stomach; the stomach-tube is often contraindicated on account of the lesions along the esophagus and in the stomach. If the patient survive, small doses of the **soluble sulphates**, well diluted, may be given at stated intervals for several days, to counteract any phenol that may have been absorbed. **Rest in bed** should be enjoined from the beginning and until recovery.

In Landouzy's treatment of poisoning by phenol, 30 to 60 minims (2 to 4 c.c.) of **sulphuric ether** should be injected immediately by hypodermic syringe. A rectal injection of 2 ounces (60 Gm.) of **sodium sulphate** in 3 pints (1500 c.c.) of filtered water is then given, the bowel being irrigated as high as possible after the manner of Cantani.

By the mouth or by means of an esophageal tube 1 ounce (30 Gm.) of **magnesium sulphate** in a quart (liter) of hot water is to be administered, as this will form an innocuous phenolsulphonate with the phenol. It may be necessary, also, to **bleed the patient** and then to perform **intravenous transfusion** or **hypodermoclysis**, the injection consisting of 300 grains (20 Gm.) of **sodium chloride** in a quart (liter) of boiled distilled water. **Morphine** injections, and **heat** applied to the extremities; and, if the fluid which has been injected into the rectum to wash it out has passed away, a small injection of **strong black cof-**

fee should be given as a respiratory stimulant. **Tea** and **hot punch** may also be administered.

The removal of 8 ounces of blood from the saphenous vein, the infusion of 4 pints (2 liters) of normal saline solution at a temperature of 100° F. (37.7° C.) into the vein, and atropine sulphate, $\frac{1}{50}$ grain (0.0013 Gm.) administered hypodermically, are advised by Oliver.

CARBOLIC ACID GANGRENE.

—See GANGRENE, vol. iv.

THERAPEUTICS.—**Oral Disorders.**—Solutions of phenol have been recommended in stomatitis, a spray of 1 grain (0.06 Gm.) to the ounce (30 c.c.) of water, or a mouth-wash or gargle containing 2 to 5 grains (0.13 to 0.3 Gm.) to the ounce (30 c.c.) of water may be used. **Offensive breath** may be sweetened by the use of a 5 per cent. spray. The cavity of a **carious tooth** may be packed with a pledget of absorbent cotton dipped lightly in a concentrated solution of phenol to relieve the pain. In **diphtheria** and **fetid sore throat** a 2 to 5 per cent. solution may be used with brush or atomizer.

Gastrointestinal Disorders.—In **nervous vomiting** or that due to gastric irritation $\frac{1}{2}$ - to 2- drop doses will afford relief by the depressant action of the acid on the nerves of the stomach. **Fermentative diarrhea** is well treated by giving 2 to 4 drops of phenol combined with 10 to 20 grains (0.6 to 1.3 Gm.) of bismuth in powder or capsule. **Cholera infantum** and **cholera morbus** are amenable to similar treatment if fermentation is present. **Vomiting after ether** can be stopped by giving $\frac{1}{4}$ drop of phenol every hour for a few hours.

Respiratory Disorders.—Weak solutions of phenol are of value in **chronic and atrophic rhinitis**, **coryza**, **hay fever**, and **influenza**; the solution (2 to 5 grains—0.13 to 0.3 Gm.—to the ounce—30 c.c.) is best used in spray. The familiar “Dobell’s solution” (liquor sodii boratis compositus, N. F.), used for cleansing the nares previous to making applications, contains a small amount of phenol.

A solution (5 to 15 drops of phenol to the ounce—30 c.c.—of water) inhaled by means of very fine spray is beneficial in **gangrene of the lung** and in **pulmonary tuberculosis**; it controls the cough and relieves the tickling in the throat. For this and other uses about the respiratory passages, **beechwood creosote** is to be preferred.

Fevers and Septic Disorders.—A favorite treatment for **enteric fever** with some is a combination of 1 part of **phenol** and 2 parts of **tincture of iodine**; 2 or 3 drops are given in mint-water every three or four hours. R. H. Quill uses phenol and spirit of chloroform (3 to 10). Charteris advises $2\frac{1}{2}$ grains, absorbed by some inert powder, in pill coated with keratin.

Septic disorders—as **variola**, **septicemia**, **puerperal fever**, etc.—have been successfully treated with phenolsulphonates; the phenolsulphonate of zinc may be given in doses of 2 to 3 grains (0.13 to 0.2 Gm.) four or five times daily.

Cutaneous Disorders.—In **parasitic skin diseases** phenol may be applied in $\frac{1}{2}$ to 2 per cent. solution: **Scabies**, **favus**, **tinea tonsurans**, **tinea circinata**, **pityriasis versicolor**, etc. In most of these diseases other remedies are preferable. In **subacute eczema** when there is a great amount of weeping and itching, a cerate of 10 grains

(0.65 Gm.) of phenol to 1 ounce (30 c.c.) of simple cerate has been recommended.

In a case of **leucoderma** treated by phenol there were numerous white patches surrounded by zones of brown pigmentation in the groins, on the abdomen and the legs, over the sacrum, the nape of the neck, and in the armpits were patches of brown discoloration only. The patches on the nape of the neck and the sacrum were painted by Savill with pure phenol. The skin resumed its normal pink color after three weeks.

A good dressing for **burns** consists of phenol and carron oil (4 grains—0.25 Gm.—of phenol to each ounce—30 c.c.—of oil). B. F. Gardner applies the pure acid to burns and then cleanses with sterilized water.

Erysipelas has been treated by subcutaneous injections of a 2 per cent. solution of phenol. These have also been used in **actinomycosis**.

Good results are obtained from phenol in **erysipelas**, by the subcutaneous injection of a solution containing equal parts of glycerin and phenol. A dose of $\frac{7}{8}$ grain (0.05 Gm.) is employed and has been found satisfactory as an analgesic and antithermic.

An ointment containing phenol and camphor has been used to mitigate the severe **pruritus accompanying variola** and to **prevent pitting**. As soon as the papules develop into vesicles the surface is scrubbed with soap and water, and followed by solution of hydrogen dioxide. The vesicles are then opened, the fluid allowed to escape, and the cavity touched with pure carbolic acid; the surface is again washed with solution of hydrogen dioxide, oiled, and covered

with cloths wrung out of phenolized water.

In many pruritic diseases, as **papular eczema**, **psoriasis**, **lichen**, and **urticaria**, or nettle rash, J. V. Shoemaker advised: Phenol, 5 to 10 drops; sublimed sulphur, $\frac{1}{2}$ dram (2 Gm.); camphor, 10 grains (0.6 Gm.); zinc ointment, 1 ounce (30 Gm.). This is to be applied frequently to the irritable surface.

Lotions containing phenol allay the **itching which accompanies jaundice**. Hare recommends: Phenol, 10 grains (0.6 Gm.), olive oil, 4 drams (15 c.c.). This to be applied frequently.

Surgical Disorders.—Phenol solution (1 to 20) has been used in surgery as an antiseptic lotion and also to keep instruments in while operating (corrosive sublimate and other antiseptics have almost entirely replaced it for the latter purpose).

For the dressing of **wounds**, phenol has been used in the form of lotion, phenolized oil, gauze, and spray. As a **local anesthetic** for minor operations (**removing toe-nail**, **opening felon**, **incising carbuncle**, etc.), it may be used by soaking the part for ten minutes in a strong solution, and afterward applying the pure phenol on a brush to the line of incision.

The injection of uncomplicated **hemorrhoids** with a 5 to 10 per cent. solution of phenol will relieve the pain; the tumor gradually shrivels up and normal defecation is at once established. Where there are several, each should be separately injected.

Local applications of pure phenol give good results in **tuberculosis of bones and joints**. The diseased tissue is carefully removed as far as possible, and concentrated phenol is applied and permitted to remain for one

or one and a half minutes, the healthy tissues being suitably protected. The phenol is then removed with pledgets of absorbent cotton, and then washed off with alcohol.

Pure phenol is an excellent application to **carbuncles** or **malignant pustule** after incision and curetting; it acts both as an antiseptic and anesthetic.

Four injections of a 2 to 3 per cent. solution into the center of a **boil** will usually bring about resolution.

For **urethral caruncle**, injections of 20 drops of a mixture of equal parts of phenol and glycerin combined with 80 drops of water may be employed.

Camphorated phenol diluted with 50 per cent. of cottonseed oil may be used with excellent results as a dressing for ulcerating **epithelioma**.

Lupus erythematosus has been cured by the continued use of undiluted phenol, which was painted over the edges of the patches once or twice a week, and boric acid ointment (4 per cent. boric acid) applied daily, and especially after applying the acid. Drop doses of Pearson's solution of arsenic (liquor sodii arsenatis, U. S. P.) were also given with nux vomica and tincture of orange-peel.

S. Sherwell, of Brooklyn, treats **nevi** by tattooing them with needles dipped into a 50 per cent. solution of phenol, afterward cleansing the surface with alcohol, and finally applying a layer of collodion. The results are said to be excellent, little or no scarring being left.

Non-suppurating **enlarged glands** may be treated by parenchymatous injections of 5 to 10 drops of a 2 per cent. solution of phenol. **Buboes** may be similarly injected with 10 minims (0.6 c.c.) of the same solution, the

skin being first benumbed by an ether spray. This treatment is also good in **chronic synovitis** (repeated every three days), and for **boils** and **carbuncles** if used early enough to abort the trouble.

For the cure of **hydrocele**, R. J. Levis advised injecting into the tunica vaginalis 15 to 20 minims (1 to 1.3 c.c.) of pure phenol, after withdrawing the fluid.

Tetanus has been successfully treated by hypodermic injections of a 1 to 2 per cent. solution of phenol, conjoined with warm baths and enemata containing chloral and potassium bromide, 12 drops being injected every three hours. After two days of this treatment a marked improvement usually manifests itself. Injections are continued until twenty-eight have been given.

Disinfectant.—As a disinfectant, phenol is only of moderate effectiveness; although a 2 per cent. solution will kill most spores and germs, many resist, and even a 5 per cent. solution requires more than twenty-four hours to kill the spores of anthrax. In all cases of disinfection by carbolic acid an exposure *by contact of some duration* is necessary. As an adjunct to other disinfection, the walls and floors of infected rooms may be scrubbed with a solution of phenol not weaker than 2 per cent. For the disinfection of wounds phenol has been replaced by other remedies, which are as efficient and less harmful, as a deodorized phenol is practically inert.

Lenti's study of the relative value of disinfectants gave the following results: 1. Alcohol in the absence of water neutralizes all bactericidal power on the part of mercuric chlo-

ride or phenol with regard to anthrax spores. The bactericidal action is not exercised until the dilution of the alcohol with water is greater than 2 per cent. in the case of 1:1000 sublimate solution, or than 70 per cent. in the case of phenol. 2. Glycerin interferes with the action of a 2:1000 solution of mercuric chloride if the proportion of water be less than 40 per cent. In the case of phenol it is still more manifest. 3. Phenol and lysol dissolved in olive oil has no disinfecting action.

DERIVATIVES AND ALLIED COMPOUNDS.—Aseptol, or Sozolic Acid.—This is a 33 $\frac{1}{3}$ per cent. solution of orthophenolsulphonic acid. It occurs as a clear, yellow to yellowish-brown liquid; has the odor of phenol; is soluble in alcohol, glycerin, and in all proportions in water; and possesses antiseptic properties. It is used as a disinfectant. It is claimed that it is free from all toxic effects, yet more efficient than phenol. It has been used externally in diseases of the **bladder, eye, and skin**, and in **diphtheria, laryngitis, gingivitis**, etc., in solutions of from 1 to 10 per cent. It should be kept from the light. Internal adult dose, 10 to 20 grains (0.6 to 1.3 Gm.).

Bromphenol.—This is a fluid analogous to chlorphenol, bromine taking the place of chlorine. It has a purple color and has less of the phenol odor than chlorphenol. Like chlorphenol, it is freely soluble in water, alcohol, and alkaline fluids. Like chlorphenol, in the form of a 2 per cent. ointment it has given excellent results in **erysipelas**. (I. Tschourilow.)

Bromol, or Tribromphenol.—This is obtained by the action between an aqueous solution of phenol and bro-

mine-water. It occurs in white to reddish crystals, of a disagreeable bromine odor, and has a sweet, astringent taste. It is insoluble in water, but soluble in alcohol, glycerin, ether, chloroform, and oils. It has been used in daily doses of 1 $\frac{1}{2}$ to 7 $\frac{1}{2}$ grains (0.1 to 0.5 Gm.) in **cholera infantum, typhoid fever**, etc., and locally to **purulent wounds** in oily solution (1 to 30) or in ointment (1 to 8), and in diphtheria in 4 per cent. solution in glycerin. Bromol has given Rademaker good results in **diphtheria**, in a glycerin solution of the strength of 1 in 25, locally applied. It may also be used in **cholera infantum**, in doses of from $\frac{1}{12}$ to $\frac{1}{4}$ grain (0.005 to 0.015 Gm.).

Chlorphenol.—This is a liquid obtained by the action of chlorine-gas upon phenol. It is a mixture of chlorphenols, and is a dense volatile fluid of pleasant odor. It has been used in the treatment of **tuberculosis, chronic bronchitis, bronchorrhea and gangrene of the lung, ozena, and laryngitis** (Passerini), by inhalation, the daily dose being from 20 to 30 drops. It has also been used locally on **ulcers** and in **purulent otitis** and **abscess of the antrum of Highmore**.

Trichlorphenol, or Trichlorophenol.—This is obtained from phenol by the action of chlorine. It occurs in white needles, soluble in alcohol and in ether, and slightly soluble in water. It is used locally in the treatment of **diphtheritic ulcers, erysipelas, chancres**, etc., in the form of a 5 to 10 per cent. solution or ointment.

Diaphtherin, or Oxyquinaseptol.—This is a yellow, crystalline powder, soluble in water and in dilute alcohol, and is a non-poisonous antiseptic. It is used in $\frac{1}{2}$ to 2 per cent. solutions or

as a dusting powder for dressing wounds, ulcers, burns, etc., in **external and median otitis** and in **eczema of the ear and nose**. In solution it does not stain the hands, but it blackens steel instruments. This discoloration can be easily removed. Diaphtherin possesses decided germicidal powers. A solution of the strength of 0.3 per cent. and one of 0.1 per cent. were sufficient to kill the *Staphylococcus pyogenes aureus* in the course of fifteen minutes and forty-five minutes, respectively.

Diaphtol, or Quinaseptol.—This occurs in yellowish-white crystals, soluble in 35 parts of boiling water, and slightly soluble in cold water. It has antiseptic and antifermentative properties and is used in solution to **disinfect the urinary tract**. It prevents the decomposition of urine better than salol.

Diaphtol is slightly toxic, but does not give rise to gastric or intestinal irritation. It is eliminated unchanged by the kidneys.

Phenosalyl.—This is a mixture of phenol, 90 parts; salicylic acid, 10 parts; lactic acid, 20 parts; and menthol, 1 part, united by heat. It has been used externally in solution, in conjunctivitis (in 0.2 to 0.4 per cent.), in **eczema** (in 1 per cent.), and in **purulent cystitis** (in 2 per cent.). Phenosalyl possesses antiseptic powers superior to the antiseptics usually employed, with the exception of corrosive sublimate. A solution of 1 per cent. suffices to kill the most resisting microbes in one minute. It has the great advantage of being non-toxic, experiments showing it to be four times less toxic than carbolic acid and a hundred times less than corrosive sublimate.

Clinical experiments with the drug were made at the Hôtel-Dieu, in Paris, in the service of Cornil, upon more than one hundred patients, who were mostly affected with genito-urinary troubles, as **endometritis, erosions of the cervix, vaginitis, and urethritis**. In every case, even inveterate ones, its use was followed by rapid recovery. In several cases of **puerperal infection** it caused the fever and other symptoms to rapidly disappear. For surgical use, injections, irrigations, etc., phenosalyl is employed in aqueous solutions of from $\frac{1}{2}$ to 1 per cent. These do not injure the instruments nor irritate the skin.

Saprol.—This is a mixture of coal-tar constituents, proposed as a cheap disinfectant. It occurs as a dark-brown, oily fluid. When added to water it floats. In 1 per cent. solution it is well adapted for the disinfection of dejecta in barracks, prisons, and schools. Of all disinfectants advocated for rendering infected stools and cess-pools innocuous, saprol most nearly answers all requirements. It forms no inefficacious compound on admixture, and readily diffuses itself among the excreta.

Tricresol is a mixture of ortho-, meta-, and para- cresols from coal-tar. It is a colorless, oily liquid, soluble in about 40 parts of water. It is a germicide and antiseptic, and does not attack instruments or benumb the hands. It is much less irritant and less poisonous than phenol or mercury bichloride. In 1 per cent. solution or ointment it is used in skin diseases and for surgical dressings. In weak solution (1:500 or 1:1000) it has been found useful as an antiseptic collyrium in ophthalmic practice.

Phenolsulphonates.—Zinc phenolsulphonate occurs as clear, colorless, column-shaped crystals, or fine, white powder, soluble in 1.7 parts of water, and in 1.7 parts of alcohol. It is largely employed as a mild, local stimulant to **foul, sluggish ulcers** or **open wounds**, and to **mucous membranes subacutely inflamed**, in powder or in solution, and in $\frac{1}{2}$ to 1 per cent. solution as an injection in **gonorrhea**. It is more commonly given internally, as a gastrointestinal antiseptic, in **fetid diarrhea** and in **typhoid fever**, in dose of 1 to 3 grains (0.06 to 0.2 Gm.) in pill four or five times daily.

Sodium phenolsulphonate occurs as clear, colorless crystals, having a slightly bitter taste, and soluble in 6 parts of water, in glycerin, and in 150 parts of alcohol. As an antiseptic it is used internally in **dyspepsia**, **tuberculosis**, **cholera**, **typhoid fever**, **flatulence**, **dysentery**, etc., in doses of 8 to 30 grains (0.5 to 2 Gm.) and as an injection in **gonorrhea**.

Magnesium phenolsulphonate occurs as colorless crystals, soluble in 1.5 parts of water, and is used as a **laxative** and **intestinal antiseptic** in doses of from 15 to 30 grains (1 to 2 Gm.).

The phenolsulphonates are probably voided by the intestines unchanged.

[Other preparations of phenol may be found under CREOSOTE, volume iii.]

C. SUMNER WITHERSTINE,
Philadelphia.

PHENOLPHTHALEIN, *Phenolphthaleinum*, U. S. P. (dioxetriphenylphthalide; paraphthalein)— $C_{20}H_{14}O_4$ —is obtained from phthalic anhydride by treating it with concentrated sulphuric acid. It occurs as a yellowish-white or almost white micro-

crystalline powder, soluble in 10 parts of alcohol and in 600 parts of water. The 1 per cent. alcoholic solution is colorless. Its solution in acid liquids is also colorless, but a red color appears when the solution is made alkaline.

Its chief use is as an indicator for caustic alkalies in the presence of alkaline carbonates; also for detecting alkaline carbonates in the presence of alkaline bicarbonates, for titrating organic acids, etc., and for testing margarine.

PHYSIOLOGICAL ACTION.—Phenolphthalein appears to have but one physiological action—that of a cholagogue purgative. Although it has been given in doses up to 30 grains (2 Gm.), a case of poisoning from taking 15 grains (1 Gm.) has been reported.

Phenolphthalein, even in small doses of 0.1 Gm. ($1\frac{1}{2}$ grains) [the U. S. P. average adult dose is 0.15 Gm. ($2\frac{1}{4}$ grains)], may cause serious hemorrhagic nephritis attended by severe anemia. Two cases also showed jaundice and serious collapse. Schliep (Münch. med. Woch., Nov. 7, 1919).

THERAPEUTIC USES.—This remedy is used medicinally as a laxative in **constipation** in doses of from 1 to 8 grains (0.06 to 0.5 Gm.); the larger doses (5 to 8 grains—0.30 to 0.50 Gm.) seem to be necessary only in obstinate cases or in bedridden patients. In **gall-stone disease** phenolphthalein has become a favorite remedy either alone or combined with calomel, or with aloin, strychnin, belladonna, and ipecac. When combined with calomel the possible necessity of administering a cathartic after the calomel is obviated. W.

PHOSPHORIC AND HYPOPHOSPHOROUS ACIDS.—Phosphoric acid as used in medicine is orthophosphoric acid. The official acid is a colorless, syrupy liquid, without odor, having an intensely acid taste. It is soluble in all proportions in water and in alcohol. When heated above 392° F. (200° C.) it changes into pyrophosphoric acid. With the

metals and the alkalies they form phosphates and pyrophosphates.

Hypophosphorous acid is a clear, colorless, and odorless, sour liquid, miscible in all proportions with water, and is decomposed at high temperatures. With the metals and the alkalies hypophosphorous acid forms hypophosphites.

PREPARATIONS AND DOSES.

—The recognized preparations are:—

Acidum hypophosphorosum, U. S. P. (30 per cent. absolute acid). Used to prepare the diluted acid.

Acidum hypophosphorosum dilutum, U. S. P. (diluted hypophosphorous acid; 10 per cent. absolute acid). Dose, 5 to 10 minims (0.3 to 0.6 c.c.).

Acidum phosphoricum, U. S. P. (phosphoric acid, 85 per cent. absolute orthophosphoric acid). Used to prepare the phosphates.

Acidum phosphoricum dilutum, U. S. P. (diluted phosphoric acid; 10 per cent. absolute acid). Dose, 10 to 60 minims (0.6 to 4 c.c.).

Calcii hypophosphis, U. S. P. (calcium hypophosphite; should contain not less than 98 per cent. of pure calcium hypophosphite. Trituration or heating with nitrates, chlorates, or other oxidizing agents causes an explosion). Dose, 5 to 30 grains (0.3 to 2 Gm.).

Ferri phosphas, U. S. P. (soluble ferric phosphate; this salt should contain ferric phosphate corresponding in amount to not less than 12 per cent. of metallic iron). Dose, 5 to 10 grains (0.3 to 0.6 Gm.).

Ferri pyrophosphas, U. S. P. (soluble ferric pyrophosphate; this corresponds in amount to not less than 10 per cent. of metallic iron). Dose, 5 to 10 grains (0.3 to 0.6 Gm.).

Potassii hypophosphis, U. S. P.

(potassium hypophosphite; should contain not less than 98 per cent. of pure potassium hypophosphite. Explosion caused when triturated or heated with nitrates, chlorates, or other oxidizing agents). Dose, 5 to 15 grains (0.3 to 1 Gm.).

Sodii hypophosphis, U. S. P. (sodium hypophosphite; should contain not less than 98 per cent. of pure sodium hypophosphite. Explosion caused when triturated or heated with nitrates, chlorates, or other oxidizing agents). Dose, 10 to 30 grains (0.6 to 2 Gm.).

Sodii phosphas, U. S. P. (sodium phosphate; should contain, in an un-effloresced condition, not less than 99 per cent. of crystallized disodium orthophosphate). Dose, 1 to 8 drams (4 to 30 Gm.).

Sodii phosphas effervescens, U. S. P. (effervescent sodium phosphate; contains sodium phosphate, 20 per cent.). Dose, 1 to 4 drams (4 to 15 Gm.).

Sodii phosphas exsiccatus, U. S. P. (dried sodium phosphate; should contain not less than 99 per cent. of pure anhydrous sodium phosphate). Dose, 5 to 30 grains (0.3 to 2 Gm.).

Syrupus calcii lactophosphatis, U. S. P. (syrup of calcium lactophosphate). Dose, 2½ drams (10 c.c.), containing about 1 grain (0.06 Gm.) calcium lactophosphate.

Syrupus hypophosphitum, U. S. P. (syrup of hypophosphites). Dose, 2½ drams (10 c.c.), containing 6¾ grains (0.4 Gm.) calcium hypophosphite, and 2¼ grains (0.14 Gm.) each potassium and sodium hypophosphites.

Calcii phosphas præcipitatus, U. S. P. VIII (precipitated calcium phosphate; should contain not less than 99 per cent. of pure calcium phosphate). Dose, 5 to 30 grains (0.3 to 2 Gm.).

Ferri hypophosphis, U. S. P. VIII (ferric hypophosphite; should contain not less than 98 per cent. of pure ferric hypophosphite). Dose, 5 to 10 grains (0.3 to 0.6 Gm.).

Sodii pyrophosphas, U. S. P. VIII (sodium pyrophosphate; should contain, in an uneffloresced condition, not less than 99 per cent. of pure sodium pyrophosphate). Dose, 15 to 45 grains (1 to 3 Gm.).

Syrupus hypophosphitum compositus, N. F. (compound syrup of hypophosphites). Dose, 2 drams (8 c.c.), containing quinine, $\frac{1}{8}$ grain (0.008 Gm.); strychnine, $\frac{1}{80}$ grain (0.0008 Gm.); hypophosphite salts of calcium, 4 grains (0.25 Gm.) of potassium and sodium, each 2 grains (0.12 Gm.), and of iron and manganese, each $\frac{1}{4}$ grain (0.015 Gm.).

Syrupus ferri, quiniæ, et strychninæ phosphatum, N. F. (syrup of the phosphates of iron, quinine, and strychnine). Dose, $\frac{1}{2}$ to 1 dram (2 to 4 c.c.).

PHYSIOLOGICAL ACTION.—Pure phosphoric acid is a local irritant and escharotic. When taken internally, well diluted, it stimulates the stomach and aids digestion. It stimulates the appetite, increases the salivary secretion, and acts as a general tonic. In large doses it acidifies the urine. Hypophosphorous acid is stimulant and tonic in its action.

Martinet holds that substances containing phosphorus (glycerophosphates, lecithin, phosphoric acid) fix it in the organism and stimulate multiplication of cellular elements: *i.e.*, the enlargement and division of nuclei and changes in multiplication. They produce a general dynamogenic action. Phosphoric acid is antialkalinic, antiseptic, and assists digestion.

F. Cautra states that anhydrous phosphoric acid has no toxic action. Guinea-pigs, killed after having ingested what would be equivalent to doses of $6\frac{2}{3}$ ounces (200 Gm.) a day for a man, showed no evidences of fatty degeneration of the kidneys or liver. The microscopic findings were those of normal organs, as also in dogs. Some of his patients have been taking from 30 to 60 grains (2 to 4 Gm.) for more than five years, without showing evidences of intolerance.

Maslow, of Petrograd, has found, experimentally, that animals are incapable of synthesizing organic phosphorous compounds. The logical conclusion is that phosphates should not be given for therapeutic purposes.

THERAPEUTICS.—The dilute acids in doses of 20 to 60 drops are useful as tonic and gastric stimulants. They are useful in **nervous exhaustion** in that they aid digestion by stimulating the stomach. In all debilitated conditions, as **anemia**, the exhaustion of **prolonged lactation**, and in **bronchial catarrh of the aged**, they are useful. Like the mineral acids, they should be given before meals in **hyperacidity of the stomach**. Phosphoric acid may be preferred to the mineral acids in **typhoid fever** when nervous prostration is a prominent symptom. The dilute acid may be used as a stimulant to **indolent ulcers**.

Cautra states that the morbid conditions in which phosphoric acid is most beneficial are those in which there is **demineralization of the organism** with **hypoacidity of the urine**. It is especially effectual when the nervous system seems to have partially lost its resisting power. True **neurasthenia**, for instance, is accom-

panied by considerable elimination of the alkaline phosphates in the urine, the logical consequence of the exaggerated consumption of phosphoric acid occasioned by the over-exertion of the brain. The nervous balance cannot be restored until the lost phosphorus has been replaced. In neurasthenics in whom the nerve-cells are secondarily affected from some digestive or other trouble, the urine will be found hypoacid with phosphaturia, and the phosphoric acid may be required for years. In **arthritis, rheumatism, tuberculosis, malaria, dyspepsia, etc.**, during the phases accompanied by demineralization of the organism, phosphoric acid will be found surprisingly effective, as also in the **nervous troubles of pregnancy and over-rapid growth.**

In skin diseases the phosphates and hypophosphites may often be substituted for arsenic, with advantage. In **boils and carbuncles, in acne indurata or inveterata, in psoriasis, and in eczema of nervous origin** calcium phosphate or the alkaline hypophosphites are valuable.

Calcium hypophosphite and the precipitated calcium phosphate are of value in the treatment of **scrofulosis, struma, and rachitis.** The hypophosphites and lactophosphites are found useful in **rickets** and in **slow and delayed union of fractured bones.** In **dental caries** and the **anemia of nursing women, in general debility and nervous prostration, and in hepatic torpor** they will do good.

The lactophosphates and hypophosphites are simply convenient modes of administering calcium, potassium, and other substances, while phosphorus acts as a stimulant to bone-growth and not by its deposition

in the bone; this difference between these salts and phosphorus should be clearly borne in mind. (Hare.)

Sodium phosphate is considered by Bartholow the best remedy in **hepatic cirrhosis and jaundice**, in doses of 20 grains to 2 drams (1.3 to 8 Gm.) in single dose or repeated several times a day, according to the laxative effect desired. Hare recommends sodium phosphate for bottle-fed children, who continually **alternate** between **diarrhea and constipation**, added in doses of 2 to 4 grains (0.13 to 0.25 Gm.) to each bottle of milk.

The hypophosphites have been largely used in the treatment of **incipient phthisis.** R. W. Gardner, of New York, has followed out the suggestions of Churchill, in the preparation of various syrups of the single hypophosphites. Churchill advises against a combination of different hypophosphites because the different bases are indicated in different stages of the disease: Soda in the incipient stage; lime in the second and third stages; quinine hypophosphite in the initial treatment of far-advanced cases, to be followed by lime or soda later on; lime reduces expectoration; soda favors expectoration; the tendency of the hypophosphites is to create plethora; therefore discrimination in dosage is necessary, when there is any tendency to pulmonary hemorrhage.

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PHOSPHORUS.—Phosphorus is a non-metallic element. In the state of combined phosphoric acid it is contained in the ancient unstratified rock and in the lavas of modern times. As these disintegrate and

crumble down into the fertile soil, the phosphates pass into the plants and ultimately as food into the bodies of man and animals. The earthy phosphates communicate rigidity to the bony skeleton.

Phosphorus was discovered in 1669, by Brandt, of Hamburg, who obtained it from urine. A century later Gahn showed that it was a constituent of bone. When pure, phosphorus very much resembles imperfectly bleached wax and is soft and flexible at common temperatures. It occurs in yellowish, semitransparent sticks, which have a waxy luster when cut. It is luminous in the dark and when exposed to the air. It is soluble in 25 parts of chloroform, very soluble in carbon disulphide (the solution being dangerously inflammable), in 50 parts of any fixed oil, in 80 parts of ether, and in 350 parts of absolute alcohol, but practically insoluble in water.

PREPARATIONS AND DOSES.

—The official preparations are:—

Phosphorus, U. S. P. (phosphorus). Dose, $\frac{1}{100}$ to $\frac{1}{20}$ grain (0.0006 to 0.003 Gm.).

Pilulæ phosphori, U. S. P. (phosphorus, $\frac{1}{100}$ grain—0.0006 Gm.) Dose, 1 to 2 pills.

The unofficial preparations, much used, are:—

Elixir phosphori, N. F. (phosphorus, 0.025 per cent.). Dose, $\frac{1}{2}$ to 2 drams (2 to 8 c.c.).

Elixir phosphori et nucis vomicæ, N. F. (elixir of phosphorus and nuxvomica). Dose, 1 dram (4 c.c.), representing 2 minims (0.12 Gm.) tincture nuxvomica and $\frac{1}{60}$ grain (0.001 Gm.) phosphorus.

Oleum phosphoratum, N. F. (phosphorus, 1 per cent.). Dose, 1 to 5 minims (0.06 to 0.3 c.c.).

Spiritus phosphori, N. F. III (tincture of phosphorus, containing phosphorus 0.12 per cent.). Dose, 1 to 8 minims (0.06 to 0.5 c.c.).

Liquor phosphori (Thompson's) N. F. (Thompson's solution of phosphorus, containing $\frac{1}{25}$ grain—0.0027 Gm.—of phosphorus in each dram—4 c.c.). Dose, 10 to 60 minims (0.65 to 4 c.c.).

PHYSIOLOGICAL ACTION.—

Phosphorus being a constituent of most tissues, it exerts a stimulating influence, when administered in small doses, upon their nutrition. This is particularly marked as regards the nervous and osseous systems. When, however, it is administered in toxic doses, it gives rise to changes in the metabolism which Münzer has summarized as follows, after an analysis of 15 cases of acute poisoning: During the first two or three days after the poison is swallowed there is a marked diminution in the total amount of nitrogen present in the urine, attributed not to the specific action of the phosphorus, but to the persistent vomiting and consequent state of starvation. On the second or third day after the poison is taken a marked increase in the excretion of nitrogen takes place, attributable to excessive destruction of tissue-proteids caused by the phosphorus. Usually death quickly occurs as soon as the amount of nitrogen has become very great; but in many cases there is a diminution both in nitrogen and of the quantity of urine excreted during the last hours of life. As regards the percentage of urea, if it is below 85 to 90 per cent. of the total amount of nitrogen excreted, disease of the liver, of such a kind as to interfere with its urea-

forming function, is thereby indicated, the absent urea being replaced by an excess of ammonia, which ought to have been converted into urea. But in some of the cases observed the quantity of urea excreted, after having been reduced very low, was subsequently increased threefold, although the condition of the liver was progressively becoming worse. The view taken is that the excess of ammonia is solely due to the development of acid products in the tissues, caused by the toxic action of the phosphorus, and not to arrest of the urea-forming function of the liver. In addition to the increase in ammonia, there is excess of uric acid excreted in cases of acute phosphorus poisoning during the stage of rapid proteid metabolism, and also of nitrogenous extractives.

The chlorides of the urine are rapidly diminished after the acute toxic effects of phosphorus develop. The excretion of phosphoric acid is increased during the first few days; afterward it progressively diminishes until death.

The excretion of sulphuric acid, upon the whole, runs the same course as that of phosphoric acid; ether sulphates are increased. No fatty acids—tyrosin, leucin—nor sarcolactic acid were found, nor any diamines. Chemical analysis of the brain-substance showed an increased percentage, and of the liver a decreased percentage, of phosphoric acid.

While hydrogen phosphide gas gives rise to the same toxic effects as those of phosphorus, red phosphorus is not poisonous; consequently the cause of the toxic quality of white phosphorus must lie in the

production of hydrogen phosphide when in contact with living tissues. In other words, when white phosphorus is introduced into the digestive tract phosphoretted hydrogen is given off, which, being easily absorbed, passes into the blood and gives rise to disturbances which prevent hematoses. This pathogenesis being granted, a new method of treatment is to be followed, which consists in acting against the formation and absorption of hydrogen phosphide.

The physiological action of phosphorus in chronic poisoning was outlined in the section on diseases of the mouth, lips, and jaw. (See NECROSIS, PATHOLOGY, volume vi.)

Experiments were made upon dogs which were poisoned by gradually increasing doses of phosphorus, given hypodermically in oil. Immediately after death the nervous tissues were fixed in corrosive-sublimate solution and stained by Nissl's method and its modifications, and with Biondi-Heidenhain solutions. In three dogs thus treated, E. Rossi found varied and diffuse changes of the cellular elements of the nervous system and of their elementary constituents. The changes in the spinal cord increased gradually from the anterior to the posterior roots. The anatomopathological process consisted in a primary degeneration of the corticomedullary cells, of those of the cerebellum and of the spinal ganglia, with a varying amount of participation of the chromophilic substance of the dendrites. No changes were observed in the neuroglia nor in the blood-vessels.

POISONING.—Poisoning by phosphorus may be acute or chronic.

Acute poisoning may occur from

an overdose of any preparation of unoxidized phosphorus, or from swallowing phosphorus paste used for destroying vermin, or from chewing the tops of lucifer matches. Red phosphorus, an allotropic form made by heating (464° to 482° F.— 240° to 250° C.) phosphorus for fifty hours in an atmosphere which is unable to act upon it chemically, is not poisonous, and has replaced to a large extent the yellow variety in the manufacture of matches. In acute poisoning the rapidity with which the symptoms appear varies. Generally in from one to eight or ten hours the peculiar, disagreeable taste of phosphorus is noticed in the mouth and the breath is heavily laden with its odor. An intense warmth in the esophagus, stomach, and bowels develops gradually into a violent, burning pain, which extends all over the abdomen. Eructations having a garlicky odor, succeeded by nausea, vomiting, and purging now follow. The vomited matters at first consist of food and later of mucus, bile, and, perhaps, blood; the color of the vomited matter is usually dark, the odor of phosphorus is present, and it with the dejecta may be luminous in the dark, owing to the presence of phosphorus. The pupils are dilated, the abdomen distended, the extremities cold, the pulse weak, and the thirst intense. Constipation is sometimes present instead of purging. Very soon the liver increases in size and is the seat of pain and tenderness.

After a lapse of twenty-four or forty-eight hours the symptoms abate and symptoms of acute yellow atrophy of the liver develop. Jaundice appears first in the conjunctivæ, and

then extends over the whole body. Vomiting and pain now return; "coffee-ground" matter is vomited, showing the presence of altered blood. The bowels are now confined, or, if moved, the stools are clay-colored, showing the absence of bile. Bile is also absent from the vomited matter. The urine is often retained. Nervous symptoms develop—muscular twitching, headache, vertigo, delirium, and convulsions or coma—and death ensues. If the patient survive the acute stage, he generally dies of general fatty degeneration of the internal organs. Recovery is rare.

The smallest doses of phosphorus known to have destroyed life were $1\frac{1}{2}$ grains (0.10 Gm.) in a man, $\frac{1}{8}$ grain (0.008 Gm.) in a woman, and $\frac{1}{50}$ grain (0.0013 Gm.) in a child. Death in cases of acute poisoning usually takes place within three to six days. In one recorded case death occurred in half an hour. Chronic cases may last for months or even years.

Chronic poisoning may result from exposure to phosphorus-fumes in match and other factories, or from the long-continued use of large doses of the drug. The most common symptoms of chronic poisoning by phosphorus are: fatigue, abdominal pains, anorexia, dyspepsia, diarrhea, sometimes obstinate constipation, intermittent headache, more or less cough, and necrosis of the lower jaw, if the teeth are carious, attended by swelling and distention of the gums with pus (see MOUTH, LIPS, AND JAWS, DISEASES OF). The complexion becomes sallow. The skin may be the seat of an eruption. The hair falls out. There is an increase of phosphates in the urine.

Treatment of Phosphorus Poisoning.—The researches of E. Q. Thornton, of Philadelphia, have developed the fact that the use of sulphate of copper as an antidote is dangerous, and that the best antidotes are **potassium permanganate** and **hydrogen dioxide**, which act chemically by oxidizing the phosphorus and thus destroying its poisonous character. Thornton prefers potassium permanganate because hydrogen dioxide is too slow in its action. The permanganate is used in a $\frac{1}{2}$ to a 1 per cent. solution by mouth (which must be given in excess, from the fact that a large portion of the permanganate is reduced by the organic substances in the stomach), or a 1:1000 solution may be used to wash out the stomach. A pint of this latter solution has been used with success a half-hour after the poison was taken.

Since large doses of potassium salts are toxic, potassium permanganate cannot always be used in sufficient quantity, and for this reason **sodium permanganate** should be substituted. Experiments with animals show this to be as effective as the potassium salt, and applicable without danger in larger doses. In cases of poisoning by phosphorus **irrigation of the stomach** with 0.2 per cent. solution, leaving a pint of the solution in the stomach, is advised by Schreiber.

Oils must be avoided in all cases, as phosphorus dissolves in them and thus absorption is favored. The value of **old turpentine** (**fatty turpentine**) should not be forgotten; it is used preferably after an **emetic** (**cupric sulphate**, 3 grains—0.2 Gm.—well diluted, repeated every five minutes until vomiting occurs).

The administration of **magnesia** or

magnesia sulphate is desirable, to empty the bowels and promote elimination. Further treatment will be directed by the symptoms present; **stimulants** and **anodynes** are usually indicated.

In chronic poisoning immediate **withdrawal from the infected atmosphere** is demanded. The **teeth and gums** of those working in the presence of phosphorus-fumes should be **carefully looked after, and kept in good order**.

THERAPEUTICS.—Certain precautions should be taken during the period of medication by phosphorus. Frequent observation of the patient is not only desirable, but necessary, for the prompt detection and relief of the first symptoms of overeffect; phosphorus should never be given in large doses; phosphorus is not indicated in diseases attended by acute or inflammatory lesions; phosphorus should never be given in substance, but in the form of an alcoholic or oily solution. Phosphorus is chiefly indicated in **malnutrition of nerve and bone**.

The beneficial action of phosphorus in certain diseases of the bones is acknowledged. In **rachitis** and **osteomalacia** phosphorus is perhaps best combined with codliver oil or lipanin (an artificial mixture devised by von Mering, as a substitute for codliver oil, consisting of 6 parts of oleic acid to each 100 parts of olive oil, and being free from disagreeable odor and taste, readily emulsified and easily digested): phosphorated oil, 16 minims (0.5 c.c.); codliver oil, 4 ounces (125 c.c.). A teaspoonful (4 c.c.) four times daily. Kassowitz suggests: Phosphorus, $\frac{1}{6}$ grain (0.01 Gm.); saccharin, 72 grains (4.8 Gm.); essence

of lemon, 2 minims (0.13 c.c.); cod-liver oil, 3½ ounces (110 c.c.). A teaspoonful three times daily. J. Comby gives the following modification of Trousseau's formula: Phosphorus, ¼ grain (0.009 Gm.); potassium iodide, 4 grains (0.26 Gm.); potassium bromide, 15 grains (1 Gm.); table salt, 2 drams (8 Gm.); fresh butter, 17½ ounces (550 Gm.). Of this mixture about ⅓ ounce (10 Gm.) is given daily, spread upon bread.

Phosphorus is a valuable tonic and restorative in **neurasthenia**, or **nervous debility**, when the system is weakened by **anxiety**, **overwork**, or **sexual excesses**. It is also a valuable tonic in the **neuralgia** of the **asthenic type**, but has little influence over pain. It is frequently given with good result in **herpes zoster**. In the weakened conditions following **acute** and **chronic alcoholism** and **morphinomania** good effects may be obtained from the administration of phosphorus. Phosphorus will support the system when exposed to **severe** and **prolonged mental and physical strain**. In **cerebral atony** and **mental enfeeblement**, even if symptomatic of **organic brain-lesion**, phosphorus will yield good results; indeed, it is not useless in **cerebral softening**, **cerebral endarteritis**, and **paralysis of cerebral origin**, and **meningitis** of a **chronic type**.

Insomnia, when due to **cerebral anemia** and **malnutrition**, has often been removed by phosphorus. **Mania** and **paralysis agitans** may be relieved, and in some cases of **locomotor ataxia** and **spinal sclerosis** improvement has followed medication by this drug. In **functional impotence** or **sexual exhaustion** the influence of phosphorus is marked.

Phosphorus is not infrequently beneficial in the treatment of **angina pectoris**.

In **anemia** small doses of phosphorus, in conjunction with iron, will yield good results. In **pernicious anemia** small doses of phosphorus seem to check the progress of the disease. In small doses, continued over long periods, it will arrest **fatty degeneration of the heart** and ameliorate the symptoms due to it. **Atheroma** of the vessels is amenable to the influence of phosphorus.

Phosphorus will be found of use as a restorative after **typhoid fever** and **typhoid pneumonia**, especially if the nervous system be particularly affected in prolonged cases; it hastens convalescence and repairs the shattered forces of the patient. Phosphorated oil is said to be valuable in **intermittent fever** and also in the eruptive fevers (**measles**, **scarlatina**, etc.) when the rash recedes or does not come out promptly. In the third stage of **pneumonia** phosphorus is said to aid resolution.

In **lupus erythematosus**, L. D. Bulkley, of New York, has found phosphorus invaluable. He uses Thompson's solution—liquor phosphori (Thompson), N. F.—as it causes less gastric and hepatic disturbance than the oily solutions or pills. He begins with 15 drops of the solution, quickly added to water and quickly taken, after meals thrice daily. The dose is gradually increased until 40 to 45 drops are taken; exceptionally, the dose may be increased to 60 drops. If gastric disturbance appear, it should be attended to and the drug stopped. If constipation be present, a pill of blue mass, colocynth, and ipecac is indi-

cated. When the gastric functions are restored, the use of phosphorus should be resumed. The treatment may be continued, with careful watching, for months, in this malady, and great benefit may be expected.

Hyperidrosis due to nervous debility is checked by phosphorus.

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PHOSPHORUS NECROSIS.

See MOUTH, LIPS, AND JAWS, DISEASES OF.

PHTHISIS. See TUBERCULOSIS, PULMONARY.

PHYSOSTIGMA. —Physostigma (U. S. P.), Calabar bean, or Ordeal bean of old Calabar, is the seed of *Physostigma venenosum*; fam., Leguminosæ: a woody creeper indigenous to western Africa along the River Niger and also found in India and Brazil. It resembles the scarlet runner and lima bean, bearing pendulous racemes of handsome, dark-purple, bean-like flowers and short, broad, 2- to 3- seeded pods. It contains 4 alkaloids: physostigmine (eserine), eseridine, eseramine, and calabarine; and physosterin (a substance related to cholesterin), starchy matters, oils, etc.

Physostigmine occurs in colorless, very hygroscopic, thin, rhomboidal lamella, which gradually assume a rose tint and even a yellow color, especially on exposure to the air, and is readily altering to a resin-like mass. It is soluble in alcohol, ether, benzene, carbon disulphide, and chloroform and sparingly soluble in water. The alkaloid is readily decomposed. Its watery solution soon becomes red, especially when heated, and

when evaporated leaves a cherry-red, amorphous residue which is insoluble in ether, but soluble in chloroform, and is called rubreserine. The same change takes place in solutions of salts of physostigmine. It forms salts with the acids, which vary in solubility; the salicylate and sulphate are official.

Physostigmine salicylate occurs in colorless or slightly yellowish, lustrous crystals, soluble in 150 parts of water. This salt is least affected by the light, but must be kept dry. Solutions of this salt deteriorate on standing and become brownish-red in color when spoiled for use; when freshly made, they are a faint-pink color.

Physostigmine sulphate occurs as a white or slightly yellowish, deliquescent, crystalline powder, of bitter taste. It is freely soluble in water and alcohol. This salt should be kept dry and away from the light.

Eseridine occurs in white, four-sided crystals, soluble in alcohol, ether, and chloroform. Eseridine is also a laxative and motor excitant, but is only one-sixth as powerful as physostigmine.

Eseramine occurs as crystals and is lacking in physiological effects.

Calabarine is a liquid, soluble in alcohol and water, but not in ether. In some respects it acts antagonistically to physostigmine and more like strychnine.

PREPARATIONS AND DOSES.

—*Physostigma*, U. S. P. (Calabar bean. Should contain not less than 0.15 per cent. alkaloids soluble in ether). Dose, $\frac{1}{2}$ to 2 grains (0.03 to 0.13 Gm.).

Extractum physostigmatis, U. S. P. (alcoholic extract of physostigma.

Powder. Alkaloid 2 per cent.). Dose, $\frac{1}{10}$ to $\frac{1}{2}$ grain (0.006 to 0.03 Gm.).

Tinctura physostigmatis, U. S. P. (tincture of physostigma, 10 per cent. strength). Dose, 15 minims (1 c.c.).

Physostigminæ salicylas, U. S. P. (Physostigmine salicylate). Dose, $\frac{1}{100}$ to $\frac{1}{30}$ grain (0.0006 to 0.002 Gm.).

Physostigminæ sulphas, U. S. P. VIII (Physostigmine sulphate). Dose, $\frac{1}{100}$ to $\frac{1}{30}$ grain (0.0006 to 0.002 Gm.).

PHYSIOLOGICAL ACTION.—

The physiological action of Calabar bean has been studied by a large number of observers, a summary of whose labors tends to demonstrate that the main effect of the drug on the nervous system is to depress the motor centers of the spinal cord. This action involves depression of the respiratory centers of the medulla, and, by reflex action, an increasing paralysis leading to paralytic asphyxia. The cerebral cortex, the sensory nerves, and the sensory nerve-centers suffer no loss of function, while the motor nerve-trunks are scarcely involved under normal circumstances. Poisonous doses, however, may cause all these structures to be more or less affected. Wood concludes that "Calabar bean acts directly either upon the muscle-structure itself or upon the peripheral nerve-endings in the muscles, producing contraction and not paralysis. The influence of the drug upon the circulation is entirely subordinate and is not at present completely understood. Early in the poisoning there is a rise of the blood-pressure, which is, in great part, if

not altogether, due to a direct stimulation of the cardiac muscle and its contained ganglia, and a slowing of the pulse also resulting from the direct action of the drug on the heart muscle. The precise action of the drug upon the vasomotor centers remains at present in doubt."

Physostigma increases peristaltic action, acts as a powerful stimulant upon the unstriated muscular fibers of the stomach and bowels, and increases their various secretions. Traversa found that physostigmine not only exaggerates the peristaltic movements, but also causes a violent and generalized contraction of the intestine and, finally, tetanus and contractures. If the contraction predominates in the longitudinal fibers, the intestine becomes wrinkled; if in the circular, it is beaded, ringed, or, if the contraction is violent and diffuse, ribbon-like. The higher nerve-centers (the vagus, spinal cord, and abdominal sympathetic ganglia) have no influence upon the production of these phenomena. A loop of intestine detached from the body and kept alive by artificial circulation gave the same reaction to physostigmine as intestines in the living body.

This indicates that the changes in motor activity do not depend upon the modification of the intestinal circulation.

Physostigmine produces exaggerated peristalsis and quite violent and diffuse contractions of the intestine solely by excitation of the peripheral motor apparatus. Traversa further calls attention to the fact that, so far as the intestine is concerned, the action of physostigmine is identical in intensity and duration as well, and of effect with pilocarpine,

not only nosographically, but mechanically.

In the eye physostigmine causes contraction of the pupil (myosis) by stimulating the motor oculi nerves peripherally, and diminished intra-ocular tension.

Given in small doses ($\frac{1}{100}$ grain or less—0.0006 Gm.) physostigmine acts as a stimulant, causing muscular twitching with increased irritability and tonus of the muscular fibers. The pulse is slowed and vascular tension is increased; the respirations are stronger and accelerated. The principal effect is on the musculature of the stomach, intestines, bladder, ureter, uterus, and bronchi, all of which are strongly stimulated. The saliva, perspiration, tears, mucus, and pancreatic juice are augmented. The pupil is contracted, but accommodation for near vision is not lost.

The temperature is little affected, if at all.

POISONING BY PHYSOSTIGMA.—In toxic doses physostigma is a powerful poison, producing extreme muscular debility, vomiting (may be absent), abdominal pain, dyspnea, and giddiness, followed by paralysis of the voluntary muscles, convulsive muscular twitchings, and invariably a contraction of the pupil. When taken by the mouth physostigmine causes paresis of the pharyngeal constrictors by a local action which Harnack considers a direct action on the secretory gland cells and the muscular fibers; others claim that the effect is due to an action on the peripheral nerve-endings. The respirations become slow and irregular, the pulse slower and weak, vascular tension falls, and there is an abolition of all the reflexes. The

temperature, especially that of the surface, is somewhat lower. Death may occur from cardiac syncope, or, if taken in smaller quantity, from paralysis of the respiratory center and asphyxia. The action on the heart is a direct one on the heart muscle and is not from stimulating inhibition. The mind is usually clear to the end. Death has occurred from 19 beans in the adult, 6 beans in a boy, and an extreme degree of collapse resulted from the hypodermic injection of $\frac{1}{20}$ grain (0.003 Gm.) of physostigmine into a child 9 years of age: profuse diaphoresis, vomiting, and collapse, with pulse 54, and scarcely perceptible and greatly diminished pupillary reflex (Lodderstädt). Marked sedation approaching collapse has followed single hypodermic doses of $\frac{1}{50}$ grain (0.0013 Gm.) (W. C. Abbott). The voluntary muscles are markedly weakened, but the involuntary muscular fibers and secretions are stimulated.

Treatment of Poisoning by Physostigma.—If the crude drug (powdered beans) or extract have been swallowed, **evacuation** (by **emetic** or **stomach-tube**) and **lavage** of the **stomach**, are indicated. To antidote the residual poison give **tannin**, 30 grains (2 Gm.) in 3 to 4 ounces (90 to 120 c.c.) of water, or give large doses of **strong tea**. To eliminate the poison from the system give 1 dram (4 c.c.) of **spirit of nitrous ether**; use **catheter** if necessary. As physiological antitodes give **atropine** hypodermically, 1 or 2 minims (0.06 or 0.12 c.c.) of a 1 per cent. solution, until pupils dilate; **strychnine nitrate** hypodermically, $\frac{1}{12}$ grain (0.005 Gm.), or **hydrated chloral**, 10 grains

(0.6 Gm.) every fifteen minutes. As stimulants liberal amounts of **strong coffee**; **brandy**, 2 to 4 drams (8 to 15 c.c.); and **aromatic spirit of ammonia**, $\frac{1}{2}$ to 1 dram (2 to 4 c.c.). The application of **external heat** to the body is advised, and if respirations are impeded **artificial respiration** by Sylvester's method is indicated.

THERAPEUTICS.—Physostigma is a useful remedy in all **spasmodic disorders**. In **tetanus** recovery has followed its use in more than 50 per cent. of cases reported by Fraser and Shoemaker, who recommended it to be given until decided physiological effects are produced. Frazer advised 1 grain (0.06 Gm.) of a good extract by the mouth ($\frac{1}{3}$ grain—0.02 Gm.—hypodermically), repeated every two hours, and increased or diminished according to the effect produced. In other nerve affections improvement has been noted, especially in **chorea**, in **epilepsy**, in **locomotor ataxia**, and in **progressive paralysis**. **Trismus neonatorum** is amenable to its action. In **infantile convulsions** it has proved effectual after chloroform had failed. In convulsive disorders of individual muscles (**tic**, **twitching of the orbicularis**, **histrionic spasm**, etc.) its action is satisfactory. In **writers' cramp** and in **hiccough** its use has been successful.

Physostigma is useful in **bronchial asthma** and **emphysema**, as it aids in the expulsion of the mucus by its action upon the muscular fibers in the walls of the bronchial tubes. Sabattier found physostigmine useful in **asthma** associated with **chronic catarrh**.

In **bronchitis**, **pulmonary congestion**, and **pneumonia**, Shoemaker found this drug useful by lowering

the excitability of the vagus, and the activity of the heart and respiration. Murrell has shown that this drug acts very favorably in the **night-sweats of phthisis**; the effect of a single dose may persist for three or four weeks: he gave $\frac{1}{60}$ grain (0.001 Gm.) of the extract in pill, two or three times during the **night**, or $\frac{1}{60}$ grain (0.001 Gm.) of eserine salts.

Physostigma is an efficient remedy in **atony of the intestines** and in **catarrh of the bowels**. Hare commends its use in cases of **gastric and intestinal dilatation**, combined with *nux vomica*. In purgative pills it is useful to stimulate the muscular fibers of the intestines and thus favor peristalsis. Shoemaker advised a combination of physostigmine with atropine to combat intestinal inhibition, and strychnine to incite the nervous centers, in the **digestive troubles of the menopause** and in **dilatation of the stomach**. In **constipation** due to defective secretion and to insufficient peristalsis the following is useful: Extract of physostigma, 3 grains (0.2 Gm.); alcoholic extract of belladonna-leaves, 1 grain (0.06 Gm.); resin of podophyllum, 3 grains (0.2 Gm.); oil of cajuput, 4 minims (0.25 c.c.). To be made into 12 pills; 1 or 2 to be taken at night. Bartholow advises equal parts of the tinctures of physostigma, *nux vomica*, and belladonna, 30 drops in water, to be taken morning and evening.

Physostigmine has been successfully used to clear the bowels before and after operations in the abdominal cavity, to prevent **postoperative intestinal atony** (Vineberg, Vogel), and to prevent the formation of **intestinal adhesions** (Vogel); for these pur-

poses a dose of from $\frac{1}{120}$ to $\frac{1}{60}$ grain (0.0005 to 0.001 Gm.) is given hypodermically, and is repeated after several hours if necessary. The action of the drug can be promoted by giving a small enema of glycerin, which affects the lower bowel alone.

Physostigma has been used successfully in **atony of the bladder** and in **vesical debility**. In these cases physostigmine strengthens the detrusor alone, having no effect on the sphincter. Giovanni, of Turin, has obtained good results from this drug in cases of **renal hemorrhage**. He combines it with ergotin: Extract of physostigma, 6 grains (0.4 Gm.); ergotin, 30 grains (2 Gm.); extract of gentian, a sufficient quantity. This makes 20 pills, 1 or 2 of which are taken daily, increased daily until effectual or the limit of tolerance is reached.

Physostigmine is a physiological antidote in **poisoning by atropine** and **by chloral**. With the bromides it may be found useful in **poisoning by strychnine**.

Waugh has found physostigmine useful in the treatment of the **morphine habit** in cases where the pupil is dilated after the morphine has been stopped, but only then; the physostigmine replaces the morphine so completely that the substitution is not detected by the patient. The dose should not exceed $\frac{1}{100}$ grain (0.0006 Gm.) twice daily. The relief lasts not more than an hour after each dose, but is absolute.

The physostigmine salts are used extensively in ophthalmic practice on account of their myotic power and their power to relieve **high intra-ocular tension**. It is not well borne in acute inflammation, or if much

ciliary congestion is present (M. L. Foster). It is positively contraindicated in the acute stage of iritis, but is used by some oculists to break up **iritic adhesions** after the subsidence of the **acute symptoms**. According to some observers, it has a tendency to increase opacities of the crystalline lens; this should be borne in mind in connection with cases of incipient cataract. In **corneal ulcerations** it is preferable to atropine, and its use may prevent **prolapse of the iris** after **wound or ulceration of the cornea**.

In the treatment of **glaucoma** this drug is generally satisfactory. A solution of physostigmine salicylate $\frac{1}{2}$ to 1 grain—0.03 to 0.06 Gm.—to 1 ounce—30 c.c.—of recently boiled water) instilled into the eye two to five times daily will reduce the tension and pain very decidedly. In some cases prolonged treatment results in permanent cure without iridectomy; in others the tension returns in a few hours after its discontinuance. In **phlyctenular keratitis** it is useful in diminishing photophobia. Cameron has used this drug successfully in **paralytic mydriasis following diphtheria**. Instillations of physostigmine salicylate solution may be used to rapidly overcome **atropine mydriasis** when desired; as the action of atropine is the more persistent, it may return as the effects of the physostigmine wear off, and necessitate a repeated use of the latter. The solutions used in ophthalmological work generally vary in strength from $\frac{1}{2}$ to 2 grains (0.03 to 0.13 Gm.) of physostigmine salicylate to the ounce (30 c.c.) of recently boiled water.

C. SUMNER WITHERSTINE,
Philadelphia.

PICRIC ACID.—Picric acid (trinitrophenol; picronitric, picrinic, carbazotic, nitroanthic, or nitrophenisic acid) is obtained from phenol (carbolic acid) by nitration. It occurs in yellowish, lustrous, flat crystals, without odor, but of an intensely bitter taste. It is readily soluble in alcohol, ether, chloroform, benzene, petroleum benzin, and slightly soluble in water (in 86 parts at 59° F.—15° C., and in 25 parts of boiling water). It is an antiseptic and an oxidizing substance.

PHYSIOLOGICAL ACTION.—The main action of picric acid seems to be exercised upon the blood, that of rabbits slowly poisoned by it having been found by Erb to assume a dirty, brownish hue. Distinct nuclei were found floating in the serum in their free state, and in the red corpuscles, while the white corpuscles were markedly increased in number. It causes distinct jaundice in man, in suitable doses, the skin, conjunctivæ, and urine being colored reddish yellow. Poisonous doses cause hypothermia, diarrhea, collapse and death.

THERAPEUTICS.—Picric acid was formerly used internally in malarial diseases, in trichiniasis, and as an anthelmintic and tonic. Experience has shown that it possesses little or no action in these conditions. In doses larger than 5 grains it is poisonous (antidote: albumin).

It is chiefly used after the method of the French surgeons, Thierry and Filleul, for the treatment of **burns** and **scalds**. In solution (1:200) it is analgesic, antiseptic, and keratogenous, and its use is free from the accidents sometimes provoked by antiseptics, as it is not irritant, caustic, or toxic. Filleul advises the use of a solution obtained by adding the crystals to boiling water, the excess being removed by decanting. The golden-yellow solution thus obtained is left to cool in a vessel stoppered with cotton to insure asepsis. After cleansing the burn and pricking all blisters, compresses of tarlatan previously boiled to remove the stiffness, or plain aseptic cheese-cloth or gauze, are dipped into boiling water, then into the solution, wrung out, and applied in several thicknesses over the burning area. Over this may be placed a layer of dry absorbent cotton, fastened in place by a roller band-

age lightly applied. The dressing dries rapidly and may be left in place several days. For removal it is moistened with the solution so as to soften it. A fresh dressing is applied and left for a week. This application relieves all pain, inhibits suppuration, and leaves a smooth cicatrix.

Hare suggests the following solution: Picric acid, 75 grains; alcohol, 2½ ounces; distilled water, 2 pints. Mix. (See BURNS, TREATMENT.)

Fortunati warmly recommends picric acid for treating **burns** of the **conjunctiva** and **cornea**, especially when caused by chemical agents, including lime. He finds that a 2 per cent. ointment made with neutral petroleum album as a base is better than a watery solution. The ointment is applied two or three times a day after the instillation of a few drops of cocaine solution. Symblepharon is rare after this treatment.

Mitchell recommends a 1 per cent. alcoholic solution of picric acid for **skin disinfection**, because it is not only germicidal, but because of its great penetrating power.

Picric acid has been employed by Chéron as a caustic and antiseptic after curetting the uterus for **fungous endometritis**; he used a watery solution (1:300). In a weaker watery solution (1:1000) it has been used in **eczema**, **erysipelas**, **lymphangitis**, **fissured nipples**, and in **impetiginous eczema**, after removing the crusts with oil.

Acute eczema is rapidly relieved under the influence of picric acid. Applied as a pigment with a brush or piece of absorbent wool, even to an extensive surface, it is quite free from danger, and causes not the slightest pain, however vascular the surface may be.

A solution of 3 drams (12 Gm.) of picric acid in one quart (1 liter) of tepid boiling water is painted over and somewhat beyond the affected surfaces; the parts are then wrapped in lint wrung out of the same solution, and over this is placed a covering of cotton-wool. Oiled silk should not be used. The dressing should be renewed every two or three days. In chronic eczema the results are not so favorable.

Picric acid has been used in watery solution (15 grains to 1 ounce) as a **test for**

albumin in urine. Though delicate, it is unreliable, as it also precipitates mucin, peptones, and potassium salts. It has also been used for the **detection of sugar** in urine, but is inferior to other well-known tests.

In pathological and histological work picric acid is used for **staining and fixing specimens**. In combination it is also used for the **decalcification of bones and teeth**.
W.

PICROTOXIN, or cocculin, is the neutral principle from the seed of *Anamirta paniculata* (cocculus indicus, Indian berry, fishberry). Picrotoxin ($C_{45}H_{50}O_{19}$) is found in the seed associated with picrotin and anamirtin. It occurs as colorless, odorless, prismatic crystals, having a very bitter taste, and is soluble in alkalies and acids, in 13 parts alcohol, and in 330 parts water.

PREPARATION AND DOSE.—While official in the B. P. as Picrotoxinum, picrotoxin is not recognized in the U. S. P. Dose, $\frac{1}{100}$ to $\frac{1}{30}$ grain (0.0006 to 0.002 Gm.). It has been used in an unofficial ointment ($\frac{1}{2}$ to 1 per cent.) for external medication. Cocculus indicus (the berries), though not official, is used externally in the form of a tincture (25 per cent.), decoction (1:16) and ointment (1:8).

PHYSIOLOGICAL ACTION.—Picrotoxin, when taken internally in medicinal doses, causes an elevation of the body temperature, and in large doses produces salivation and vomiting. This drug stimulates the origins of the inhibitory fibers of the vagus, the vascular and respiratory centers, and the motor areas of the medulla. It possesses an anhidrotic action very similar to that of pilocarpine and muscarine, and is antagonized by atropine and its congeners.

Picrotoxin causes a slowing of the pulse, by stimulating the cardiac inhibitory centers in the medulla and by its direct depressing effect on the heart muscle. The arterial pressure is increased.

Large doses cause stupor and epileptiform convulsions, the latter occurring as marked clonic movements following a period of tonic muscular contraction, and being due to irritation of the motor cells in the medulla and spinal cord.

The respirations are at first accelerated, but during the spasms the breathing is interrupted; during the intervals of quiet and collapse following, the breathing is resumed. The respiratory depression, however, increases until the breathing fails to be resumed after a spasm, and death from asphyxia results.

POISONING BY PICROTOXIN.—Picrotoxin and cocculus indicus are very poisonous to the lower forms of life, and to many act as acrid, narcotic poisons. In the lower animals convulsions precede death. Poisoning may follow its external use or from swallowing a toxic dose of the drug. A fatal case is cited by J. V. Shoemaker where a child, 6 years old, was poisoned by the absorption of a strong alcoholic solution of the berries used on the scalp, in whom tetanic convulsions occurred. The convulsions are, however, usually of the epileptiform type. As a possible source of poisoning, we must bear in mind that cocculus is sometimes added to malt liquors to save hops and check fermentation. This may be an active element in drunkenness from the use of malt liquors and explains why intoxication should be viewed as a condition of poisoning demanding prompt and intelligent treatment.

Treatment of Poisoning.—This condition should be met with the use of **emetics** and **siphonage of the stomach**. **Tannin**, **chloral**, and the **bromides** are the most efficient antidotes, and should be used in connection with **inhalations of ether or ammonia**, and the internal or hypodermic administration of **stimulants**. The antagonism between chloral and picrotoxin is without question and can be utilized even when the poisoning has occurred from absorption through the integument.

THERAPEUTIC USES.—Fishberry, or cocculus indicus, is used against **phtheiri-asis (lousiness)**, but care must be taken, especially in children or when abrasions of the scalp exist, not to use strong solutions, nor to leave them too long in contact with the skin. One part of cocculus tincture to 8 parts water, or a decoction (1:16) may be applied to the scalp, after thorough cleansing, left on a few minutes and then well washed off

with warm water. Two or 3 daily applications are usually sufficient. An ointment of picROTOXIN (2 per cent.) has been used, but is not safe. A weak ointment ($\frac{1}{2}$ to 1 per cent.) combined with ointment of mercuric oleate is valuable in animal and vegetable parasitic diseases, as **scabies**, **pediculosis**, **trichophytosis**, and **tinea versicolor**.

In small doses it may be of service in **gastric atony**, **intestinal indigestion**, **flatulence**, **colic**, **painful dyspepsia**, and **deficient metabolism**.

Its use in **epilepsy**, **chorea**, and **paralysis** has only in part met the claims made by Planat and Hammond, Gubler, Phillips and others. As an anhidrotic it has proved its value in the **night-sweats of phthisis**, and in other forms of **hyperidrosis**.

Bókai suggests picROTOXIN as an antidote in **opium poisoning**, by reason of its stimulating action upon the respiratory and vasomotor centers. It may, for the same reason, be used in **chloral poisoning** and in **poisoning by strophanthus**. W.

PIEDRA.—Piedra, or trichosporosis tropica, first scientifically described by Desenne in 1878, is a mycotic disease found in parts of South America, causing small, very hard nodosities on the hair. This disease of the hair is common in some parts of Colombia, especially in the valley of Canca, but allied conditions are observed in India and Ceylon, and occasionally in temperate zones (piedra nostras).

SYMPTOMS.—In women the hair of the head—and, less frequently, the hair of the head and beard of men—is affected. The affected hairs are the seat of strings of pinhead nodosities, easier felt than seen. These nodosities are located on the surface of the hair shaft, on one side alone or inclosing it. They may be very numerous, are black and hard, though not so hard as the name piedra (stone) would suggest. A peculiar crepitation is produced when the hair is combed. Matting and knotting of the hair is not infrequent. The disease is chronic and does not disappear spontaneously.

DIAGNOSIS.—The diagnosis is made by the microscopic examination of the nodosities.

ETIOLOGY AND PATHOLOGY.—

In trichosporosis tropica, if an affected hair is washed in ether, and then treated with liquor potassæ, and then examined microscopically, we find the nodule to consist of large polyhedric refringent bodies held together by an amorphous substance acting as a cement (Castellani). These bodies are the spores of the pathogenic fungus (*Trichosporum giganteum*, Behrend, 1890).

In trichosporosis Indica (India and Ceylon) the fungus is somewhat different, the disease less severe, a few nodules only being found on the hairs of the beard, the scalp usually escaping.

In trichosporosis of temperate zones (piedra nostras or tinea nodosa) the nodosities have been found on the hairs of the beard, not on the hairs of the head (Beigel, 1869). The fungi differ slightly from *T. giganteum*. Several species have been described.

PROGNOSIS.—The disease lasts long. There is no spontaneous cure.

TREATMENT.—Treatment has been unsatisfactory. Castellani advises the application of **benzene** and **turpentine** to the hair and regular washing of the head with a 1:2000 **bichloride solution**. It may be necessary to **shave the head**. W.

PILES. See HEMORRHOIDS.

PILOCARPUS AND PILOCARPINE.—

Pilocarpus, or jaborandi, consists of the dried leaflets of the South American trees *Pilocarpus jaborandi* and *Pilocarpus microphyllus*, belonging to the family Rutaceæ. The leaflets are oblong to obovate in shape, thick and smooth, and possess an aromatic odor and an aromatic, bitter, and pungent taste. When chewed they produce an increased flow of saliva. The leaflets of the jaborandi species, which of late years has become very scarce, are much larger than those of the microphyllus variety. Pilocarpus contains the alkaloids *pilocarpine*, *isopilocarpine*, and *pilocarpidine*, having similar actions,

together with *jaborine*, the action of which resembles that of atropine, but which is present in too small amounts to exert any appreciable effect. These alkaloids, in the uncombined state, are all syrupy or oily liquids, except *jaborine*, which is an amorphous solid. They form crystalline salts. Fresh pilocarpus contains also a volatile oil and a stearoptene or camphor-like body belonging to the olefine series.

PREPARATIONS AND DOSE.—

Pilocarpus, U. S. P. (*pilocarpus*; *jaborandi*), required to contain not less than 0.5 per cent. of alkaloids. Dose, 5 to 50 grains (0.3 to 3.3 Gm.); average, 30 grains (2 Gm.), containing about $\frac{1}{7}$ grain (0.01 Gm.) of alkaloids.

Elixir pilocarpi, N. F. III (elixir of pilocarpus), every 2 fluidrams (8 c.c.) of which represents $7\frac{1}{2}$ grains (0.5 Gm.) of pilocarpus. Dose, 2 to 4 fluidrams (8 to 16 c.c.).

Fluidextractum pilocarpi, U. S. P. (fluidextract of pilocarpus or *jaborandi*), so prepared by maceration, percolation, dilution, and assay, as to contain 0.6 per cent. of the pilocarpus alkaloids. Dose, 10 to 60 minims (0.6 to 4 c.c.); average, 30 minims (2 c.c.), containing about $\frac{1}{8}$ grain (0.008 Gm.) of alkaloids.

Pilocarpinæ hydrochloridum, U. S. P. (pilocarpine hydrochloride) [$C_{11}H_{16}N_2O_2.HCl$], occurring in colorless or white crystals, odorless, having a faintly bitter taste, and deliquescent on exposure to the air. It is soluble in 0.3 part of water, 2.3 parts of alcohol, and 540 parts of chloroform. Dose, $\frac{1}{12}$ to $\frac{1}{2}$ grain (0.005 to 0.03 Gm.); average, $\frac{1}{5}$ grain (0.01 Gm.).

Pilocarpinæ nitras, U. S. P. (pilocarpine nitrate) [$C_{11}H_{16}N_2O_2 \cdot$

HNO_3], occurring in colorless or white, shining crystals, odorless, with a faintly bitter taste, and permanent in the air. It is soluble in 4 parts of water and in 60 parts of alcohol; but is insoluble in chloroform. Dose, $\frac{1}{12}$ to $\frac{1}{2}$ grain (0.005 to 0.03 Gm.); average, $\frac{1}{5}$ grain (0.01 Gm.).

MODES OF ADMINISTRATION.—The drug is generally used in the form of subcutaneous injections of the pilocarpine salts, the latter being preferable to the crude pilocarpus, in that nausea and vomiting are less often caused. For instillation in the eyes, 2-grain (0.12 Gm.) to the ounce (30 c.c.) or 1:200 solutions are generally employed. Externally, as an addition to hair washes, the fluidextract of pilocarpus is frequently used, being less expensive than the alkaloid.

Internally, the action of pilocarpine is uncertain and slow in comparison with its effects when administered by hypodermic injection; it seems that quite alarming cardiac depression may be thus brought on without any previous perceptible diaphoresis (Willoughby).

In administering a pilocarpine "sweat," the patient must be put to bed. His nightshirt should be removed and he should be wrapped closely in a very warm, dry blanket, over which two other blankets should be thrown and tucked in all round the bed. Hot-water bottles, encased in flannel, should be put to his feet, and hot drinks may be given by the mouth freely. The pilocarpine is then to be administered hypodermically, the amount given being usually about $\frac{1}{6}$ grain (0.01 Gm.). The strength of the solution used varies: (1) 1 grain (0.065 Gm.) of pilocarpine nitrate in 20 minims (1.30 c.c.) of distilled water, the dose

being 2 to 6 minims (0.13 to 0.39 c.c.); or (2) 1 grain (0.065 Gm.) in 12 minims (0.78 c.c.), with a dosage of 1 to 4 minims (0.06 to 0.26 c.c.). Profuse sweating should begin within half an hour, and may continue for from half an hour to two hours. If free perspiration does not come on, it is advisable to give the patient a tumblerful of cold water to drink slowly; the vasoconstriction that results in the splanchnic area serves to drive more blood to the surface of the body and thereby facilitates sweating.

After sweating has ceased, but not before, the blankets should be removed gradually, the skin rapidly but thoroughly dried, and the patient left between fresh, warm, dry blankets. (The Hospital, June 22, 1907.)

INCOMPATIBILITIES.—Pilocarpine salts in solution are incompatible with alkalies, iodides, potassium permanganate, and salts of the heavy metals, such as mercury, silver, and gold.

CONTRAINDICATIONS.—Pilocarpine should not be employed internally, or given in full dosage by hypodermic injection, where the heart is weak or there is a tendency to pulmonary congestion and edema. In comatose patients the use of pilocarpine is attended with some danger, owing to the increase of salivary and bronchial secretions it causes, which, in a patient whose reflexes are obtunded, may lead to serious interference with the respiratory and cardiac functions.

PHYSIOLOGICAL ACTION.—**Externally**, pilocarpine exerts no action, except possibly a stimulation of the hair-follicles, which has been ascribed, in turn, to excitation of the glands of the scalp, with consequent better local circulation and improved nutrition to the follicles.

General Effects.—*Nervous System.*—On the nerve-centers of the brain, pilocarpine has but little effect. Even in poisoning, the mind remains clear. The spinal cord and medulla are, however, depressed by large doses. Peripherally, pilocarpine powerfully stimulates the endings of the nerves constituting the so-called “autonomic” or vagosacral system.

Circulation.—Pilocarpine is typically a depressant to the heart, slowing its rate, in large doses, through stimulation of the cardioinhibitory vagus nerve-terminals. A moderate fall in the blood-pressure may occur in consequence. In some instances, however, the drug, at least at first, accelerates the heart slightly—through depression of the vagus centers—and raises the blood-pressure. After toxic doses of pilocarpine the heart muscle is itself directly depressed and at the same time the vessels become dilated through depression of the vasoconstrictor center in the medulla, a fall in blood-pressure therefore occurring.

The leucocyte count of the blood, as well as its sugar content, are increased by pilocarpine.

Intravenous injections of pilocarpine nitrate in the dog produce a rapid increase in the output of lymphocytes through the thoracic duct. The lymphocytosis of the blood is probably the result of this increased output. The true cause of the quickened lymph flow is not clear, but it may result from contraction of smooth muscles. Rous (Jour. of Exper. Med., May, 1908).

Respiration.—This is unaffected by ordinary doses of pilocarpine. Excessive amounts not only depress the respiratory centers, but bring about increased bronchial secretion and a

contraction of the involuntary muscle-tissue in the bronchial walls, thus tending to promote a condition of asthmatic respiratory embarrassment which, in conjunction with the frequently coexisting depression of the circulation, readily results in edema of the lungs and grave asphyxia.

Secretions.—Pilocarpine powerfully stimulates many of the secretions, in particular the sweat secretion, which may be so activated that from four to nine pounds of body weight is lost through the elimination of water by the skin after a single large dose. This sweating takes place even after the nerves of the glands have been sectioned, and is ascribed to excitation of the terminals of the nerves in the secreting cells, or of these cells themselves. The sebaceous glands are also stimulated, the sweat being therefore rendered acid or at least neutral in reaction owing to the fatty acids in the sebaceous secretion.

Among other secretions markedly increased by pilocarpine are the saliva and the bronchial mucus. The lachrymal secretion, the ear-wax, all mucous secretions, and the gastric, intestinal, and pancreatic secretions are also more or less augmented.

Report of experiments performed on the salivary secretion in dogs, in which a permanent salivary fistula had been established some weeks or months before. In 4 dogs therefore 0.5 mg. atropine was sufficient to neutralize the effects of 5 mg. of pilocarpine on the salivary secretion. The ratio of atropine to pilocarpine, in which they suffice to neutralize each other, was found to be constant in the series of animals. In the same dog the ratio of the pilocarpine to that of the atropine necessary to oppose its action remained the same however much the actual amounts

injected might vary; *i.e.*, the antagonism was found to proceed according to the laws of mass action, and not according to those of chemical combination. There was evidence that when one poison had been allowed to act for some time, its antagonist was less effective than if it had been injected simultaneously. A. R. Cushny (Jour. of Pharm. and Exper. Therap., March, 1915).

The deep-seated glands, such as the gastric or pancreatic, are affected by pilocarpine only when they have been previously stimulated to physiological activity by some irritant, the effect of the drug being to heighten the excitability of the terminals of the secretory nerves. The normal irritant for the gastric and pancreatic glands is hydrochloric acid, introduced either artificially or in the course of normal digestion. Popelski (Vratch, xxii, No. 15, 1901).

The mammary, biliary and renal secretions are, on the other hand, not believed to be directly affected; the urinary output may, in fact, be considerably diminished owing to the pronounced loss of water through the skin. According to some, small doses of pilocarpine tend to increase urinary secretion. All the secretory effects of pilocarpine can be prevented or overcome by atropine.

Pilocarpine affects the output of urine both indirectly through loss of fluid from other glands and also, and probably to a greater extent, by its constricting action on the musculature of the ureters. D. Cow (Proc. Royal Soc. of Med.; Med. Rec., March 22, 1913).

The amount of sugar in the milk has been found increased by pilocarpine.

Muscular Tissues.—Stimulation of the nerve-endings in involuntary muscle-tissue analogous to the effect on the nerve-endings in glands takes

place under pilocarpine, but its effects are manifest only after larger doses, chiefly in the form of increased gastrointestinal motility together with contraction of the bronchi, bladder and pupils. The uterus and smooth muscle of the blood-vessels do not appear to be affected. The voluntary muscles are likewise uninfluenced.

Eyes.—Instilled in the eye, pilocarpine solutions cause (1) marked contraction of the pupil, reaching its height in one-half to one hour and subsiding after three or four hours; (2) stimulation of the ciliary muscle, with consequent spasm of accommodation and constant adjustment of the eye for near vision, and sometimes a dull pain due to the unusual activity of the ciliary muscle, and (3) a preliminary rise in intraocular tension, which may last half an hour and is believed to be due to increased secretion of the humors of the eye, followed by a more pronounced and characteristic fall in the pressure, ascribed to the broadening of the spaces of Fontana, or lymphatic outlets of the eye when the surrounding tissues are drawn apart through contraction of the iris. Effects (1) and (2) are due to stimulation of the endings of the oculomotor nerve in the constrictor muscle of the iris and the ciliary muscles, respectively.

Absorption and Elimination.—Pilocarpine is absorbed rather rapidly, and is eliminated in the urine, sweat, and saliva.

POISONING.—Serious and even fatal results have followed the injection of medicinal doses of pilocarpine; $\frac{1}{3}$ grain (0.02 Gm.) has been known to cause, in addition to profuse diaphoresis, salivation, lachrymation, a discharge from the nose, nausea,

dyspnea, and a sense of cardiac oppression. Rémy mentions a case in which the remedy induced a series of epileptic attacks. In another case the patient suddenly expired directly after an injection had been made.

Lethal doses are usually followed by copious sweating, flushed skin, dizziness, salivation and swelling of the salivary glands and tonsils, lachrymation, discharge from the nose, hiccough and strangling, nausea and abdominal cramps and vomiting, diarrhea, a tearing pain in the eyeballs, myopia, dimness of vision, strongly contracted pupils, prostration, dyspnea, cardiac oppression, and sometimes a bloody leucorrhea. The circulatory condition is at first one of excessive vagus action and vasomotor depression, with consequent slow or even intermittent (heart-block) cardiac action and low blood-pressure, followed by direct cardiac impairment and the symptoms of collapse. The dyspnea is due to augmented bronchial mucous secretion or actual pulmonary edema, together with bronchoconstriction. Ascending motor paralysis may be observed, but consciousness is likely to remain until the exitus, which occurs typically from pulmonary edema. The occasional report of cases of accident following the administration of medicinal doses of pilocarpine imposes some degree of caution in the use of this remedy.

Case of extensive eruption following the prolonged use of pilocarpine. The patient, a man aged 52 years, had episcleritis and increased ocular tension, for which instillations of 0.05 per cent. solution of pilocarpine and hypodermic injections of 0.05 to 1 cgm. ($\frac{1}{120}$ to $\frac{1}{6}$ grain) of the same drug were prescribed. Under this

treatment the vision improved, but after 35 hypodermic injections and about 80 instillations an eruption appeared which occupied the face, the trunk, and the limbs, and was polymorphous, consisting of papules, vesicles, pustules, and impetiginous crusts; some of the lesions were umbilicated. Symptoms of systemic intoxication accompanied the eruption, and at the end of two months the patient died. Histological examination of the eruptive lesions revealed an inflammatory exudate about the excretory ducts of the sweat-glands. The eruption was unaccompanied by fever. Hallopeau and Viellard (*Annales de dermat. et de syphil.*, No. 3, 1904).

Treatment of Pilocarpine Poisoning.—**Atropine** should at once be given hypodermically in full doses— $\frac{1}{50}$ to $\frac{1}{15}$ grain (0.0012 to 0.004 Gm.), as physiological antidote. In its absence, any preparation of **belladonna** or other drug containing atropine, or even **scopolamine** (hyoscyne) in moderate dosage may be employed. Where **jaborandi** has been taken internally, the **stomach-tube** or an **emetic** should be used. The drug itself tends to produce vomiting which, if it persists unduly, may be combated with **morphine**.

In patients in whom symptoms of spinal or circulatory depression, such as motor paresis and collapse, are witnessed, stimulants such as **strychnine**, **caffeine** or hot, strong **coffee**, and **ammonia** preparations, should be freely used, together with **artificial respiration**. Partial **inversion** of the patient may be of service in freeing the bronchial tubes of excessive secretions and preventing descent of the latter into the pulmonary air spaces, with the consequent restriction of respiratory surface.

THERAPEUTICS.—As a **diaphoretic**, pilocarpine is generally to be preferred to **jaborandi**, as it is less likely to produce nausea and vomiting. In **chronic nephritis** and **uremia** pilocarpine injections may do much good through elimination of the excess of urea and related nitrogenous compounds with the sweat. A daily dose of $\frac{1}{4}$ grain (0.015 Gm.) of pilocarpine hydrochloride, or 10 minims (0.6 c.c.) of the fluidextract of pilocarpus three times daily may be administered with advantage (Tyson). In general, however, pilocarpine is considered of secondary importance to external applications of heat (sweat baths), owing to the greater likelihood of secondary depression and the possibility of its inducing pulmonary edema or impairing heart action. In **acute scarlatinal nephritis** pilocarpine has been used with benefit, though Griffith considers it dangerously depressant in children, and recommends it only for adults. In the uremia of **puerperal eclampsia** pilocarpine may be of marked benefit, but in some cases it does more harm than good by its depressing influence.

Jaborandi is capable of bringing about, upon continued use, favorable results in **nephritis**, **acute** as well as **chronic**. The usual dosage administered by the author was 20 minims (1.25 c.c.) of the fluidextract (sometimes combined with **nux vomica** and **digitalis**), to be taken every three hours until the skin and kidneys were acting well; then three doses daily.

In using the **jaborandi** continuously, the specific gravity of the urine would remain the same, or even be increased, as the secretion of urine increased. Casts became more numerous in the beginning of the treatment. After decided improve-

ment took place, the quantity of urine became less, until little more than the normal quantity was passed; then, as the quantity of urine decreased, the specific gravity returned to normal. The author feels confident that jaborandi must act in some special manner upon the kidneys, assisting nature to free the tubes when they are obstructed with epithelial or fibrous *débris*. A. P. Dearborn (Mass. Med. Jour., May, 1907).

Pilocarpine has been used in general **dropsy**, **ascites**, and **hydrothorax**. In dropsy of renal origin it is a valuable agent, but when the condition is due to cardiac trouble it is too depressing. In hydrothorax it is of considerable value, but thoracentesis is, perhaps, best, and elaterium or salines come next in efficiency.

Successful results have been reported from the use of pilocarpine in **acute erysipelas**. Da Costa recommends the hypodermic administration of $\frac{1}{6}$ grain (0.01 Gm.) every three hours until free sweating ensues, then every four to six hours. The diaphoresis is at once followed by retrocession of the rash and improvement in the general condition.

When dealing with atonic cases of erysipelas, when the heart is weak and perspiration cannot be established by pilocarpine, no beneficial action is observed. The best results are obtained in early cases.

In **nephrolithiasis** with **anuria** due to renal congestion, Meara recommends, where facilities for the hot pack or hot-air bath are not at hand, pilocarpine hydrochloride in doses of $\frac{1}{10}$ to $\frac{1}{5}$ grain (0.006 to 0.012 Gm.).

Some consider pilocarpine useful as a renal stimulant in doses of $\frac{1}{30}$ to $\frac{1}{20}$ grain (0.002 to 0.003 Gm.), either hypodermically or by mouth.

Pilocarpine is indicated when there are a dry, hot skin, parched mouth, full and strong pulse, with the kidneys not able to perform their work, and the patient is restless or convulsive. A man working on low, marshy land had contracted **malaria**. His temperature was 105° F. (40.5° C.) and pulse 130, full and bounding. He had not had bowel action for three days, nor voided urine for twelve hours. The author gave $\frac{1}{2}$ grain (0.03 Gm.) of pilocarpine hypodermically, and within five minutes ptialism and perspiration became profuse. The patient passed a large quantity of highly colored urine, and soon afterward vomited easily a large quantity of "bilious" matter. The vomiting from pilocarpine is, in a sense, a regurgitation, as the stomach seems to empty itself without the usual straining after emetics. In two hours the patient's bowels moved freely. More was thus accomplished with one large dose of pilocarpine than could have been accomplished in three days with the usual cathartics, emetics, diaphoretics, and diuretics. The patient was thus thoroughly cleansed and made ready for antiperiodic doses of quinine. E. B. Ellis (Med. World, vol. xxi, No. 9, 1903).

In **epidemic parotitis** (mumps) pilocarpine has been claimed to afford relief when given early. In the treatment of **orchitis** and **epididymitis** accompanying this affection, injection of $\frac{1}{6}$ grain (0.01 Gm.) of pilocarpine on alternate days is asserted by Martin to shorten the duration of the inflammation, and also act as an anodyne. Harnsberger likewise recommends pilocarpine in orchitis and epididymitis, however caused, including cases of **gonococcal orchitis** in which the usual measures have failed to relieve.

Chronic rheumatic disorders and **sciatica** may be ameliorated by

diaphoretic doses of pilocarpine. In a patient who suffered from two or three attacks of rheumatism yearly, Drapier gave hypodermic injections of $\frac{1}{6}$ grain (0.01 Gm.) of pilocarpine, which led to complete recovery within six days. In **acute muscular or articular rheumatic** conditions following exposure to cold, pilocarpine may be used with benefit in the early stages, preferably in small doses and followed by quinine.

The fulgorant pains of **tabes dorsalis** can sometimes be relieved with subcutaneous injections of pilocarpine.

Among the **respiratory affections** in which pilocarpine may prove useful is **acute bronchitis**, in the early stages of which $\frac{1}{20}$ to $\frac{1}{10}$ grain (0.003 to 0.006 Gm.) of pilocarpine nitrate may be given by mouth thrice daily, or somewhat smaller doses subcutaneously, to loosen and augment the scanty bronchial secretions. In **chronic bronchitis** the drug may also prove efficient where the secretions are thick and evacuated with difficulty. The same applies to **plastic bronchitis**, in which small doses of the drug may be given at short intervals to assist in loosening the fibrinous membranes formed in the bronchial lumina. In **chronic atrophic laryngitis** pilocarpine, given in $\frac{1}{10}$ -grain (0.006 Gm.) doses three times daily is of value to promote the secretory activity of the local glandular structures. The local use of from 1 to 5 minims (0.06 to 0.3 c.c.) of fluidextract of pilocarpus to 1 ounce (30 c.c.) of water as a spray has been suggested by J. Solis-Cohen in the same affection. In **bronchial asthma**, in spite of the well-known bronchoconstricting effects of large doses of

pilocarpine, small doses, such as $\frac{1}{20}$ grain (0.003 Gm.), have at times proven of value in the acute dyspneic paroxysms. In **edema of the larynx**, pilocarpine may be used to help deplete the dropsical mucous membrane by causing diaphoresis; great care as to dosage is, however, required to avoid undue circulatory depression in these already partially asphyxial cases, and incision of the affected membrane is a more direct and logical measure.

In obstinate **hiccough**, pilocarpine is one of the numerous remedies which have been credited with beneficial effects. Harnsberger considers it indicated whenever firm pressure upon the base of the tongue fails to give relief, and advises its use also in tonic **spasm of the diaphragm**.

In persistent **catarrhal jaundice**, subcutaneous injection of $\frac{1}{6}$ to $\frac{1}{4}$ grain (0.01 to 0.015 Gm.) of pilocarpine on alternate days has sometimes proven effective in relieving the condition, in spite of the prevailing view that this drug has no stimulating action on biliary secretion. Mitkowski has, moreover, attributed diagnostic value to the procedure; if the treatment produces no effect upon the jaundice, the presence of a malignant growth is to be suspected. In **hepatic colic**, Harnsberger strongly recommends $\frac{1}{8}$ grain (0.008 Gm.) of pilocarpine with $\frac{1}{2}$ grain (0.03 Gm.) of codeine subcutaneously, to be repeated if required.

Probably the easiest and most rapid way to remove **ranula** is by the administration of $\frac{1}{6}$ grain (0.01 Gm.) doses of pilocarpine hypodermically (Harnsberger).

In **skin disorders** characterized by a deficient secretion of the sweat-

glands, and in those of rheumatic origin, pilocarpine has at times proven effective. In **chronic eczema**, Koltz obtained favorable results from hypodermic injections of 10 to 15 drops of a 1 per cent. solution of pilocarpine. Poulet suggests that the same procedure may be of service in the treatment of **elephantiasis**. It has been observed that jaborandi has alleviated **urticaria**, and doses of $\frac{1}{20}$ grain (0.003 Gm.) of pilocarpine have proven remedial in **hyperidrosis** and **bromidrosis**.

In the late **syphilides**, when mercury and the iodides are not effective, pilocarpine, given alone or combined with the antisyphilitic treatment for a period, will often clear the skin. The author has found it most efficient of all remedies in the tertiary stage for **leukoplakia**. Tongues that withstood prolonged antisyphilitic treatment cleared up in two weeks upon the addition of pilocarpine.

In nursing mothers in whom the **mammary function** is not fully developed and the secreting cells not sufficiently active, pilocarpine is a valuable galactagogue. G. Merrill Hawkins (Med. Council, Feb., 1913).

Pruritus is not uncommonly relieved by this agent. The **itching of jaundice** is amenable to it if the drug is well borne and diaphoresis ensues. Simon has found nothing so useful as pilocarpine hypodermically in the treatment of **pruritus senilis**. It relieves the itching and allows the patient to sleep.

In **alopecia** the use of pilocarpus internally—or, better, its application locally—seems to encourage the growth of the hair. Pringle has specifically shown that by injection of $\frac{1}{2}$ grain (0.03 Gm.) of pilocarpine nitrate into the scalp, a growth of hair can be obtained. If too much of the

drug is used, small pustules may develop about the hair-follicles. The following application has been suggested for cases of alopecia:—

R *Fluidextract of pilocar-*

pus ʒj (30 c.c.).

Tincture of cantharides. ʒss (15 c.c.).

Soap liniment ʒiiss (45 c.c.).

Sig.: Mix and apply night and morning with friction.

For the same purpose Hare suggests the use of:—

R *Fluidextract of*

pilocarpus fʒj (4 c.c.).

Tincture of capsic-

cum ʒj (30 c.c.).

Tincture of can-

tharides fʒss (2 c.c.).

Castor oil fʒj (4 c.c.).

Alcohol, q. s. ʒiv (125 c.c.).—M.

Dryness of the tongue and aptyalism may be relieved by small doses of pilocarpine. The dryness of the mouth often so troublesome in **diabetes mellitus** may be alleviated in the same manner. On the other hand, minute doses of the drug have been recommended in the **night-sweats of pulmonary tuberculosis**, in **ptyalism**, and in **bronchorrhea**.

Pilocarpine is useful in all **ophthalmic disorders** associated with increased ocular pressure. De Schweinitz recommends very highly the hypodermic use of pilocarpine ($\frac{1}{10}$ to $\frac{1}{2}$ grain—0.006 to 0.03 Gm.—daily) for **opacities** of the vitreous humor. Diaphoresis should be avoided. As a myotic (1 to 4 grains—0.06 to 0.26 Gm.—to the ounce—30 c.c.) pilocarpine may be substituted for eserine; 1 or 2 drops every hour may be used until the pupil is sufficiently contracted.

Pilocarpine is useful as a tonic to the eye; to relieve **ocular pain** after excessive use of the eyes, $\frac{1}{10}$ grain (0.006 Gm.) of pilocarpine and 4

grains (0.25 Gm.) of boric acid to the ounce (30 c.c.) of distilled water may be used, a few drops of the solution being placed in the eye at a time. Clinical observation has shown that pilocarpine in small doses is a good remedy in **tobacco amblyopia** and **alcoholic amblyopia**. A few drops of a 2-grain (0.13 Gm.) solution of pilocarpine may be employed locally with advantage in **rheumatic iritis**. Staderini advises pilocarpine nitrate, $\frac{1}{10}$ to $\frac{1}{8}$ (0.006 to 0.008 Gm.) hypodermically in many inflammatory diseases of the eyes, especially in those consequent upon rheumatism, as **episcleritis**, **iritis**, and idiopathic **optic neuritis**. Gratifying results have been reported by Hansell from the use of the drug, hypodermically or by the mouth in alkaloidal form, or as small doses of the fluid-extract of pilocarpus, in **interstitial keratitis**, **traumatic purulent iritis**, and **retinochoroiditis**. He confirms the observation that the persistent nausea so common after the use of the drug is usually relieved by small doses of chlorodyne. Bock reported good results from injections of small amounts (2 to 3 cgm.— $\frac{1}{3}$ to $\frac{1}{2}$ grain) of concentrated solutions of pilocarpine in cases of **blood in the anterior chamber**.

Some nerve-specialists place great reliance upon pilocarpine in **toxic insanity** after **influenza**, **autointoxication**, and similar processes, the brain rapidly clearing after two or three sweats.

In cases of obstinate **aural vertigo**, a most efficient treatment is the use of pilocarpine every few days in sufficient doses to produce some salivation, the patient lying down or going to bed after each dose. Labit has re-

ported cases of **Ménière's disease** in which the daily hypodermic use of pilocarpine gave satisfactory results. In **syphilitic deafness** pilocarpine may prove of value when combined with the customary antisyphilitic measures. In **deafness and vertigo due to inflammatory disease of the labyrinth**, injections of $\frac{1}{6}$ to $\frac{1}{3}$ grain (0.01 to 0.02 Gm.) of pilocarpine on successive or alternate days, according to tolerance, are recommended. After an initial dosage of $\frac{1}{12}$ grain (0.005 Gm.), the amount should be increased until free sweating and salivation take place. Where the hearing fails to improve after 12 injections, the treatment should be discontinued (Pershing).

While atropine is a very efficient antidote against poisoning by pilocarpine, pilocarpine is less potent as an antidote in **poisoning by atropine**. McGowan has related a case, however, in which two injections of $\frac{1}{2}$ grain (0.03 Gm.) each were undoubtedly the means of saving the life of a patient suffering from belladonna poisoning. The same procedure is recommended as beneficial in **acute alcoholism** and in **poisoning by methyl alcohol**, in which free elimination of the poison by all possible routes is desirable.

In **tetanus**, the sedative action of large doses of pilocarpine on the spinal cord has occasionally been utilized with success.

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PIMENTA.—Pimenta (allspice) is the dried, nearly ripe fruit of *Pimenta officinalis* (family, Myrtaceæ), of Tropical America. It contains from 2 to 4 per

cent. of volatile oil (*oleum pimentæ*), mostly in the pericarp; resin, tannin, fat, sugar, mucilage, etc.

PREPARATIONS AND DOSES.—

Pimenta, U. S. P. (allspice). Dose, 10 to 40 grains (0.60 to 2.60 Gm.).

Oleum pimentæ, U. S. P. (oil of allspice). Dose 2 to 5 minims (0.10 to 0.30 c.c.).

PHYSIOLOGICAL ACTION AND THERAPEUTIC USES.—*Pimenta*, like other drugs containing aromatic oils, is a pungent, aromatic stimulant and is used as a carminative, a flavoring, a digestive stimulant, and to prevent the griping of purgatives. For the last purpose this oil is added to the pill mass. It is occasionally used as an ingredient in spice plasters. W.

PINEAL GLAND, DISEASES AND ORGANOTHERAPY OF.

—PHYSIOLOGY.—This organ has had a varied career. Descartes thought it contained the soul; its connection with the pineal eye of reptilia and other low vertebrates caused it to be classed with the vestigial organs, but it has been raised to the rank of a useful organ. It contains neuroglia and what are regarded as secretory cells. Certain of its follicles contain what is termed "brain sand," also found in the choroid plexus and elsewhere, but devoid, as far as is known, of physiological importance.

As to the functions of the pineal, it is thought in some way, perhaps through a secretion, to control growth in the young. Destructive tumors of the pineal in children under the seventh year may cause them to become abnormally tall and prematurely developed as to their genital organs, hair growth, and ossification. Obesity is occasionally observed in these cases. In keeping with these clinical facts Sarteschi found that in rabbits pinealectomy

caused great body development, sexual precocity, and notable enlargement of the testes. Notwithstanding all this, the feeding of pineal gland to young animals by Dana, Berkeley, Goddard and Cornell, and McCord also caused them to outgrow the controls rapidly in activity, size, intelligence, and resistance to intercurrent disease, while in children it has appeared to benefit certain cases of retarded development, though not cases of total idiocy and gross physical defect.

These contradictory results emphasize the fact that little is known concerning the actual functions of the pineal. Some believe that the organ controls growth, its deficiency allowing other glands to stimulate development abnormally.

Forty-seven cases of pineal tumors are on record; the 15 patients with sarcoma were between 10 and 20 years old and all but 1 were males, as also the 4 carcinoma patients (aged 19 to 24), the 6 with glioma, the 5 with teratoma, and each of the other varieties except the 8 cystoma cases, which were all in women except 2. The features of the cases all confirm the assumption that the pineal gland is concerned in the development of the secondary sexual characters in males. Children with pineal-gland tumors show giant growth and premature development of the genitals and hair on the body. H. Rorschach (*Beiträge z. klin. Chir.*, April, 1913).

TUMORS.

Various types of growth are met with in the pineal. The main forms found are sarcoma, glioma, teratoma, carcinoma, cystoma, and neuroglioma.

SYMPTOMS.—Tumors usually occur among young subjects. In practically all forms of neoplasms

the characteristic symptoms are: abnormal growth as to height, premature genital and sexual development and also hair growth, a tendency to obesity, change of voice to that of an adult and mental precocity. These phenomena clearly suggest participation of the pituitary body in the morbid process.

Teratoma of the pineal gland found at autopsy—the fifth recorded case. The patient was a 5½-year-old boy. His father and 2 uncles had cleft palate and 2 other children had congenital anomalies. From the third year the boy developed precociously, both mentally and physically, being especially tall. Five months previous to death pressure symptoms developed, such as strabismus, choked disk, and headache. Four weeks before death there were marked growth of the penis, erections, and growth of the pubic hair. L. Frankl-Hochwart (*Deut. Zeit. f. Nervenheilk.*, Bd. xxxvii, Nu. 5, 6, 1910).

Adiposis has been recorded in a number of cases of pineal tumor. Next in importance to the increased fatty growth is the early development of the sexual characters. This early sexual development has shown itself as an enlargement of the penis, increase in the genital hair or general hairiness of the body, increased libido usually manifested by early masturbation, and, in some cases, changes in the voice. In other cases the menses have been interfered with. Cachexia is often a symptom. Whether this has any relation to the pineal, or is a symptom of the hydrocephalus, or of the tumor itself, cannot yet be determined. Pearce Bailey and S. E. Jelliffe (*Arch. of Internal Med.*, Dec., 1911).

In some cases there is hydrocephalus, due to pressure upon the veins of Galen and the aqueduct of Sylvius, the liquid filling first the third ventricle and passing down into the pituitary. The symptoms of dis-

ease of the latter may then be added to those of pineal origin.

In a case of pineal tumor examined *post mortem* by the writer, the pituitary was reduced to a thin stratum less than a millimeter in thickness. Destruction of the pituitary would, according to this, seem to play a more important rôle in the pathogenesis of the "pineal syndrome" than exaggerated function of the pineal body. Apert (*Soc. de Pédiat.*; *Bull. méd.*, Aug. 6, 1913).

Case of a child which at the age of 4 months developed hydrocephalus with spastic paresis, and later showed signs of pineal tumor, is reported by the author. The hydrocephalus soon came to a standstill, but the child remained backward intellectually, whereas physically, on the contrary, there was marked precocity. At 18 months the pubis became hairy, the reproductive organs developed, and the voice changed. X-ray examination favored the idea that pineal tumor existed in this case as in previously reported cases confirmed at autopsy. Van der Heide (*Bull. méd.*, Aug. 6, 1913).

Case of probable pineal disease in a man 28 years old, of diminutive stature, without hair on the face or axillæ, and but slight growth on the pubes. For months there had been headache and vomiting. Optic atrophy consecutive to neuritis was found. Carbohydrate tolerance was unaltered, and there was no change in the size of the bones; nor any in the size of the thymus. The X-rays disclosed internal hydrocephalus, with atrophy of a portion of the sphenoid bone. F. X. Dercum (*Med. Rec.*, Apr. 8, 1916).

Severe headache, vomiting, great lassitude, deviation of the eyeballs, amaurosis, papillary edema, somnolence, and vertigo are also observed, but these are obviously pressure symptoms. These may be followed later by motor phenomena such as increased muscular tonus,

myasthenia and increased tendon reflexes. Pressure exerted upon the corpora quadrigemina may cause ocular palsies, paralysis of associated movements, and nystagmoid phenomena. If the geniculate bodies and posterior corpora quadrigemina are compressed, there may be tinnitus, crackling and buzzing and progressive deafness. Pressure on the cerebellum may cause staggering gait; both this symptom and ataxia are not infrequently present.

Polydipsia, polyuria, and glycosuria are occasionally observed, probably when the pituitary body is involved in the morbid process. Giant growth of acromegalic type, sometimes witnessed, is also due in all likelihood to involvement of this organ. In a case described by Henrot some years ago, sarcoma of the pineal and pituitary was found *post mortem*.

TREATMENT.—The treatment of pineal tumors is surgical, removal of the growth being indicated. The pineal may be exposed by Monaco's operation the steps of which are extensive superior median craniotomy, ligation of the longitudinal sinus, retraction, separation of the two hemispheres and partial splitting of the corpus callosum—all with very strict antiseptic precautions. Where hydrocephalus is present, lumbar puncture may be tried.

ORGANOTHERAPY.—Pineal gland has given good results in cases of retarded development in children. It stimulates normal growth of the body and enhances intellectual activity, in certain cases. Where total idiocy and gross physical defects are present no benefit is to be expected; it is doubtful whether these are to be

ascribed to a secretion. From my viewpoint they are more likely to be due to the nucleins which the pineal contains.

The writer used pineal extract in 54 obstetrical cases. In 15 cases he did not reach his patients until the third stage of labor, when he witnessed good effects in retained placenta and hemorrhage. The results were also excellent in the remaining 39 cases—not inferior to those obtained with hypophysis extracts, though in 11 cases the author was evidently compelled to use forceps. In 5 minutes after an injection, strong pains, with sufficient intermissions, ensue. Wolf (*Deut. med. Woch.*, Aug. 7, 1913).

A comprehensive study showed that the pineal was practically devoid of any marked pharmacological action. Its extirpation from young animals also failed to produce deleterious effects. F. Fenger (*Jour. Amer. Med. Assoc.*, Dec. 16, 1916).

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PINK EYE. See CONJUNCTIVA, DISEASES OF.

PINTA.—Pinta, also known as Mal de los Pintos, Caraate, Tina, Quirica, Pannus Carateus (Alibert), etc., is not applied to a single disease, but to a group of allied dermatomycoses, characterized by the presence of patches of various color, due to different species of fungi of the genera *Aspergillus*, *Penicillium*, *Monilia*, and *Monoyella* (Castellani). Pinta is practically found only in tropical America (Venezuela, Peru, Chili, Central American States, Mexico, and, more rarely, Brazil. In Colombia, 4 per cent. of the population is affected (Montoya), and the affected patient is called "caratejo." Dirt and poverty are etiological factors.

SYMPTOMS.—The onset of the disease is very gradual. After an incubation period of from a few weeks to months, one or several slightly itching spots appear, on uncovered parts of the body, increase very slowly in size, and may coalesce. They may be round or irregular in shape,

at first but slightly raised, the surface usually dry and rough, and covered with fine pityriasic squamæ in recent cases, but larger and thicker scabs in older ones. In chronic cases the surface of the patches may be moist, somewhat greasy, or glutinous, instead of dry.

The hairs of the affected regions become atrophied and later are shed, due to a fibrosis of the hair-follicle and not to the fungus.

Pruritus, especially at night, is marked. In the palms and soles patches of hyperkeratosis often appear, making the normal lines and sulci apparently deeper. A peculiar, nasty odor, like that of cats' urine or of musty, dirty linen, is noticed in old chronic cases. The whole body, excepting the palms and soles, may become affected. The scalp is seldom affected, the nails never.

The disease is very chronic,—may last a lifetime,—with no tendency to spontaneous cure. Six varieties are distinguished, according to the color of the patches: black, blue, violet, red, yellow, white.

The same patient may be affected with several varieties.

DIAGNOSIS.—In the countries where the disease is endemic, the diagnosis is easy. Microscopic examination, supplemented by cultural methods, will reveal the diagnosis.

TREATMENT.—When the disease first appears the application of **tincture of iodine** may prove effectual. **Mercury nitrate ointment** is much used in Colombia. **Chrysarobin in zinc oxide ointment**, 2 to 6 per cent., may be applied cautiously, but never to the face. For the face a **resorcin** (6 per cent.); or **resorcin 6, acid salicylic 2, petrolatum 100**; or **citrine ointment**, may be used. **Chrysarobin in chloroform** (10 per cent.) is applied with a fine brush to the patch by Montoya, which, when dry, is covered with **solution** (10 per cent.) of **gutta-percha in chloroform**.

When large tracts of the body are the seat of pinta, and chrysarobin is employed, a small portion only should be treated at a time, to prevent absorption of the remedy. Constant watch should be kept on the urine during treatment. S.

PIPERAZIN. —Piperazin (pyrazin hexahydride, diethylene diamine; piperazidin; ethyleneimin) is obtained by the action of ammonia upon ethylene bromide or chloride. It occurs in colorless, transparent, deliquescent needles, which absorb carbonic acid from the air. It is very soluble in water, the solution being practically tasteless and having an alkaline reaction. It must be kept from the air.

Piperazin is incompatible with alkaloids and the salts of iron, tannic acid, alum, preparations of cinchona, Donovan's solution, potassium permanganate, sodium salicylate, acetanilide, and phenacetin.

Dose.—The dose of piperazin is 15 grains (1 Gm.) per day. This quantity is dissolved in a pint of plain or carbonated water and taken in tumblerfuls at equal intervals. The solution must be prepared fresh each day.

It cannot be prescribed in pill form on account of its highly hygroscopic nature.

PHYSIOLOGICAL ACTION.—Piperazin forms with uric acid piperazin urate, a neutral and very soluble salt, even if the uric acid is present in excess. Upon its solvent power over uric acid rests its value in practice. Piperazin will render soluble twelve times as much uric acid as lithium carbonate; moreover, piperazin urate is seven times as soluble in water as lithium urate.

When taken in moderate doses it is quickly eliminated by the kidneys, and gives the urine a brownish-red color. Ebstein and Sprague did not find by examination of the latter that the output of uric acid or urea was increased; indeed, Voght has argued that in doses of 15 grains (1 Gm.) a day it checked uric acid elimination.

POISONING BY PIPERAZIN.—The following untoward effects have been observed when large doses have been given: Feelings of nervousness and apprehension (hallucinations); intermittent clonic spasms of the upper extremities, spreading to the muscles of the abdomen and legs, the patient becoming dazed, unable to think clearly, and for some hours partly unconscious; muscular prostration, with inco-ordination; coarse tremors, uncertainty of gait for several days, due

rather to impairment of co-ordination than to any paretic condition of the muscles.

Slaughter reported a case of poisoning from 20 grains (1.25 Gm.) of piperazin taken at once.

Treatment of Poisoning by Piperazin.—**Cardiac and respiratory stimulants** are strongly indicated. **External heat** should be applied to the **limbs and trunk**, and the **lower limbs elevated**. A **high, stimulating rectal injection** should be administered and the **patient catheterized**. The paralytic symptoms (paraplegia) will be best relieved with large doses of **strychnine**.

THERAPEUTICS.—Piperazin was introduced as a solvent of uric acid. It has been found an effective remedy in various manifestations of the **uric acid diathesis**. **Renal and vesical calculi**, due to the deposit of uric acid, have been disintegrated and expelled through the use of piperazin. It has been given with the idea of preventing the formation of renal and vesical calculi. It is useful in **irritation and inflammation of the bladder** arising from an **excess of uric acid in the urine**. For this purpose it may be given internally, or the bladder may be irrigated with a 1 per cent. solution.

It has been used in **diabetes** and has been found especially useful when associated with **gout**. It has been found beneficial in **renal colic** and in **hemorrhage from the urinary passages**.

ALLIED SUBSTANCES.—**Lycetol.**—This is also known as dimethylpiperazin tartrate; it is claimed that this substance is superior to piperazin, as the tartaric acid is supposed to be converted into carbonic acid, alkalizing the blood, and dissolving uric acid. It occurs in a fine, granular, white powder, and is soluble in water. It has a diuretic effect, an agreeable taste, and is non-hygroscopic. It may be used in **gout** in daily doses of 15 to 30 grains (1 to 2 Gm.).

Lysidin.—This is also known as methylglyoxalidin, or ethylene-ethenyldiamin, and is obtained by dry distillation from sodium acetate with ethylenediamin hydrochloride. It occurs in pinkish, hygroscopic crystals, having a mousy odor. It is readily soluble in water, and has been

recommended by Ladenburg as being non-toxic, five times superior to piperazin in dissolving **uric acid**, and as not causing digestive troubles or albuminuria. It is given in doses of from 3 to 15 minims (2 to 10 c.c.) of the 50 per cent. solution, daily, in 1 pint (0.5 liter) of cold or carbonated water, in cases of **uric acid diathesis** and **gout**. W.

PITCH. See **TAR**.

PITUITARY BODY, DISEASES OF. See **ACROMEGALY**, vol. I; for **TUMORS OF**, and **HYPOPITUITARISM**, and also for **HYPOPHYSEAL SYNDROME** and **FRÖHLICH'S SYNDROME**, see vol. i, p. 298, and vol. vii, p. 157; for **PITUITARY ORGANOTHERAPY**, see **ANIMAL EXTRACTS**, vol. i.

PITYRIASIS.—Pityriasis (seborrhea, dandruff, sebaceous ichthyosis, eczema seborrhœicum) is a disorder of the fat-producing glands of the skin, characterized by an increase, decrease, or alteration in the secretion of sebum, resulting in an oily, crusted, or scaly condition of the skin. Two varieties are recognized, pityriasis simplex (seborrhea sicca) and another, usually called seborrhea oleosa. In the former there is diminished secretion, with an exfoliation of cells; in the latter there is an excessive flow of sebum or seborrheal flux. It may be due to systemic acidosis.

Pityriasis simplex (seborrhea sicca) is commonly observed on the scalp and face. In the former location it is known as dandruff and occurs as fine, branny, whitish or grayish scales which are loose and drop readily from the hair to the coat-collar. The scalp is most often dry and pale, but may present a certain degree of redness. The hair becomes dry, lacks the usual luster, and tends to split.

When the face is affected it is usually found in the eyebrows, at the root of the nose, in the nasolabial furrow, and in the beard. When these parts are the seat of inflammation the condition is called seborrhœic dermatitis, or eczema. The process may involve the whole face (pityriasiform seborrhea sicca). **Crusted**

forms may occasionally be seen upon the face, scalp, sternum, pubes, umbilicus, or elsewhere, the secretion being greasy, yellowish, or brownish. **Crusta lactea**, or milk crusts of infants, is classified under this affection by Kaposi.

Seborrhea oleosa, the other form of pityriasis, manifests itself as an excessive oiliness of the skin. When the scalp is affected the hair and scalp are greasy, moist, glistening, and sticky, the hair having a tendency to become matted. The oil soon reaccumulates even after thorough washing, and if the scalp is not regularly cleansed the oily matter becomes rancid and it is the source of a disagreeable odor. When the face is affected it is usually seen upon the middle third (forehead, nose, chin, and adjacent parts of the cheek), and the skin is observed to be abnormally oily, and to have a dirty appearance from the adhesion of dust. The sebaceous follicles may be the seat of dark-colored plugs, or an oily secretion may exude from them. The superficial blood-vessels about the nose are usually enlarged.

DIAGNOSIS.—The dry form is differentiated from eczema by the absence of inflammation. The oily variety is easily diagnosticated by the greasiness of the skin and the enlarged pores.

ETIOLOGY.—Sabouraud has studied and described a microbacillus which he claims is pathogenic in the oily form. The dry form is believed to be due to coccic infection of parasitic origin, and unrelated to the oil-glands.

TREATMENT.—In the way of general treatment, **outdoor life, exercise, bathing**, etc., are advised. Duhring recommends **calcium sulphide**, $\frac{1}{2}$ grain (0.012 Gm.) three times daily. Sabouraud favors the natural **sulphur waters** (Luchon, Calles). **Codliver oil, iodine, phosphorus, iron, and arsenic** are useful.

Local Treatment.—**Remove the crusts or scales** and then use **stimulating and astringent applications** to restore the normal functions of the glands. To soften the crusts upon the scalp, Schamberg advises the use of **salicylic acid**, 1 dram (4 Gm.) in **olive oil**, 6 ounces (180 Gm.), followed by the use of **tincture of green soap** to remove the **débris**. The green

soap is used alone if the hair is greasy, using only gentle friction, so that the scalp may not be unduly irritated. A small amount of **sulphur ointment** (1:8), rubbed into the scalp, is valuable, and Schamberg combines with it a **resorcin lotion** (1:24) made of equal parts of alcohol, cologne-water, and plain water. The lotion and ointment are used on alternate nights. If the scalp becomes too dry, **glycerin**, $\frac{1}{2}$ to 1 dram (2 to 4 Gm.) may be added; if more stimulation is desired, add **betanaphthol**, 30 grains (2 Gm.) to the lotion.

Mercurial ointment and **lotion** may be used on the scalp, but not in connection with sulphur. **Mercury nitrate** or **ammoniated** in benzoated lard (6 to 8 per cent. ointment) may be used, or a lotion of **mercury bichloride**, 1 to 3 grains (0.06 to 0.20 Gm.); **glycerin**, 1 dram (4 Gm.); **bay-rum**, 6 ounces (180 c.c.). When employed upon the face the remedies must be of milder strength: a **resorcin lotion** (1:48), or an **ointment of resorcin and precipitated sulphur**, of each, 10 grains (0.6 Gm.) in lanolin and cold cream, of each, 4 drams (15 Gm.).

PITYRIASIS ROSEA.

Pityriasis rosea (pityriasis maculata et circinata; herpes tonsurans maculosus) is a rare disease, first described and named by Gilbert. It may or may not be ushered in with fever, though fever is seldom absent, and usually with severe headache. Macular or maculopapular patches, principally on the trunk, appear after the fever. The face and limbs are sometimes invaded, and more rarely the affection begins upon and is limited to the upper extremities. The lesions may be elevated slightly, on the level of the skin surface, or may be depressed. The patches vary in size from a pin's head to a split pea, or larger, and may be either isolated or confluent. They are round or oval, mostly light or dark red, gradually becoming yellow, and are dry and scaly, with a tendency to spread at the periphery and heal in the center. A zone of erythema surrounds the primary lesion. Neighboring patches may coalesce, forming semi-circles, circles, or disks, when the typical lesion has a yellowish or fawn-colored

center, with pinkish, slightly elevated border covered with branny scales. Glandular enlargement may be present. The disease is self-limited, lasting from two to eight weeks, usually six. Itching is slight, but may be severe at night.

ETIOLOGY.—The rarity of the disease and its self-limitation suggest that some antitoxic substance is produced in the body. The cause is obscure and the contagion feeble, if present.

DIAGNOSIS.—From **ringworm** it is distinguished by the absence of the specific fungus. From **seborrheic eczema**, which may resemble it when situated upon the trunk or limbs, the presence of seborrhea, seborrheic scales, or eczema of the scalp is of diagnostic value. Patches of **psoriasis** develop and extend more slowly, the scales are more silvery and profuse, and the scalp and extensor surfaces the usual sites.

PROGNOSIS.—Always favorable. It disappears spontaneously.

TREATMENT.—There are no internal remedies of any value. Mildly **stimulating and antiseptic ointments** may be used locally—**betanaphthol** or **sulphur** (10 per cent.). When the itching is annoying, Schamberg uses the following lotion: **phenol** and **glycerin**, each 1 dram (4 Gm.); **witchhazel extract**, 1 ounce (30 c.c.); and water to make 8 ounces (250 c.c.). Barduzzi advises **plain diet, alkaline diuretics**, and, perhaps, a **saline cathartic**.

PITYRIASIS RUBRA.—This disease has been treated under **DERMATITIS EXFOLIATIVA** (see vol. iii, p. 806), the term most usually applied to pityriasis rubra.

PITYRIASIS VERSICOLOR.

This is a vegetable parasitic skin disease characterized by furfuraceous, yellow, macular patches (flava), occurring chiefly on the trunk. Castellani describes two other varieties (alba and nigra) which are seen in the tropics in addition to that best known in the temperate zones (flava). It is also known as *tinea versicolor* and *chromophytosis*.

SYMPTOMS.—Pityriasis versicolor flava is first seen as pinhead- to pea-sized, yellowish macules, distributed over the affected region. In the course of a few weeks or months they grow larger

and coalesce, forming large patches, which are irregular in shape, have sharply defined edges, slightly elevated above the surface of the skin, but occasionally raised sufficiently to form a ring (annular form). The typical color is *café au lait*, or fawn-colored; exceptionally it may vary from a pale yellow to a brown, or it may be pinkish; in negroes it may be grayish. Fine, furfuraceous, mealy scales cover the affected region.

It pursues a chronic course, disappearing or growing less in the cold months and reappearing with the warm season. It is an adult disease and but slightly contagious.

ETIOLOGY.—This disease is caused by the presence and growth of a vegetable fungus first described by Eichstedt in 1846. Robin called it *Microsporon furfur*. Castellani terms it *Microsporon tropicum*. The variety known as pityriasis versicolor alba is due to *Microsporon macfadyeni*, and pityriasis versicolor nigra to *Microsporon mansonii*.

DIAGNOSIS.—This is made by finding, under the microscope, the characteristic fungus, in scrapings from the fawn-colored patches on the patient's trunk. The spores may be more easily seen if the scrapings are mounted in a solution of equal parts of glycerin and alcohol. **Chloasma** is seen usually in the face, and is not scaly. The same applies to **vitiligo**, and in addition there is a lack of color in the patch, which is surrounded by an excess of pigment. The **macular syphiloderm** is more red, and there is more symmetry and more uniformity in the size of the patches.

PROGNOSIS.—The prognosis is good, but relapses are frequent, as the fungi in the skin are usually not thoroughly destroyed.

TREATMENT.—Hot baths, frictions with **sapo mollis**, and the application of a **parasiticide**—solution of **sodium thiosulphate** (1:8), or of **mercury bichloride** (0.2 per cent.) will cause its disappearance in a few weeks. Lotions or ointments of **sulphur, mercury, tar, thymol, resorcin**, etc., may be used. In all cases the applications should be continued for some time after the eruption has disappeared, to prevent relapse.

W.

PIX LIQUIDA. See TAR.

PLAGUE (BUBONIC PLAGUE).

—**DEFINITION.**—A virulent infectious disease due to a specific organism, the *Bacillus pestis*, characterized by the formation of one or more buboes, or by the development of a violent form of primary confluent pneumonia.

It is the most fatal of all known acute diseases. At an extremely moderate estimate more than 80 out of every 100 stricken with it die. That this statement is conservative will be seen when it is stated that in India, during the fourteen years, ending with December, 1907, out of 6,842,980 cases, 5,571,288 died.

The disease has never been known on the Atlantic Coast of the United States nor until very recently on the Pacific Coast. Since 1894, however, at which time it was limited to the province of Yunnan, China, it has been steadily travelling toward this country in both directions. While in 1894-95 it was confined to one country, within six years it has reached every continent and obtained a foothold in 51 different states. Of these, 2 are dependencies of the United States (Hawaii and the Philippine Islands) and 2 are in the United States,—California (San Francisco, Oakland, Berkley and Point Richmond) and Washington (Seattle). It has twice gained a footing in San Francisco and only by the most persistent efforts and unstinted use of money has it been stamped out. Our increasingly frequent communication with the Orient makes us constantly liable to its introduction. (Penna. State Depart. of Health, May, 1910).

VARIETIES.—Two main varieties of this disease are usually recognized: the *simple bubonic*, about 80 per cent. of all cases, in which buboes appear in the femoral, inguinal, axillary, cervical, or tonsillar regions; and the *pneumonic*, in which no buboes appear

on the surface, the septic process manifesting itself mainly in the lungs, mesentery, gastrointestinal tract, kidneys, or brain. Besides these, three rarer forms have been identified: the *septicemic*, a severe type in which the blood and lymphatic system is overrun with plague bacilli; the *cellulocutaneous*, in which the skin and often the lymph-nodes are the seat of infection; and *Pestis ambulans* or *minor*, a mild form in which the lymph-nodes are affected.

SYMPTOMS.—After an incubation varying from two to seven days, the disease is suddenly ushered in with a chill, the temperature rising somewhere between 101° and 105° F. (38.3° to 40.5° C.). The patient reels like a drunkard, owing to marked vertigo, and complains of violent headache and great lassitude. This sudden and early exhaustion is apparent in the features, the drooping eyelids, the apathetic air, and the evident indifference to surroundings constituting the *facies pestica* characteristic of the disease. The patient complains of general neuromuscular pains or aches. The pulse becomes rapid—a sign of importance in this disease. The respiration is also rapid, as a rule; the face and conjunctivæ are congested, and keratitis, iritis, or panophthalmia are sometimes observed. The tongue is swollen, shows the impression of the teeth, and is covered with a whitish fur resembling mother of pearl. The bowels are as a rule constipated, but diarrhea may supervene. There is usually a polynuclear leucocytosis.

In severe cases (*Pestis siderans*) the patient soon falls into collapse, the urine is scanty or suppressed; delirium and uremic coma or convul-

sions supervene, and the patient dies, in a fourth of the cases, in twenty-four hours or less.

In the *bubonic* form the bubo appears during the first twenty-four or forty-eight hours of the malady, and is usually unique. In the order of frequency it presents itself in the groin, the axilla or the neck, or internally. It develops with rapidity on one or both sides and may be well advanced as early as the beginning of the second day; it is always very sensitive to the touch almost from the start. The neighboring tissues are tumefied and edematous, especially in the parotid region. When this locality is invaded edema of the larynx is to be feared.

On the second day the bubo is about the size of a pigeon's egg, and there is aggravation of all the constitutional symptoms, the pulse reaching sometimes 140. Delirium now appears and the stage of apathy is replaced by one of excitement, during which the patient may try to get up. Psychical disorders become manifest, fixed ideas predominating. Functional disturbances of speech are also frequently observed. On the third day all the symptoms become still further aggravated, the pulse reaching 140 or beyond, and the bubo attains perhaps the size of a hen's egg, and suppurates. Occasionally it becomes gangrenous. Carbuncles may develop in different parts of the organism. Extensive petechiæ are usual: the "plague spots" of older writers. Hemorrhages from mucous membranes, the nose, the lungs, etc., are frequently observed. In some epidemics hemorrhages are witnessed in all cases, the buboes assuming an hemorrhagic type.

Death, in the majority of fatal cases, generally occurs about the fourth day, either from toxic paralysis of the respiratory or cardiac centers or from collapse. If the first four or five days—the acute stage—are passed safely, the chances of recovery are favorable. On the other hand, a stage of marasmus or profound depression may appear on the fifth day and the patient succumb on the sixth. Much depends upon the condition of the heart. Some cases, especially in children, are very benign, showing but an insignificant rise in temperature, slight inguinal or axillary pain, general depression, and ephemeral torpor. Such cases, however, are apt to occur early in the course of an epidemic. On the whole, the disease shows a very high rate of mortality.

In the *pneumonic* form the pulmonary inflammation closely resembles incipient influenza and does not show clear physical signs. It is characterized by the development of patches of bronchopneumonia without apparent or noticeable implication of the lymphatic system. It also begins with a chill, severe pain in the side, and more or less severe cough, serosanguineous expectoration, and other phenomena recalling a pneumococcic pneumonia. The fever is usually high; delirium and prostration are very marked. The plague bacillus is always found in the latter. In this variety death may occur in from twenty-four hours to five days, and occurs in about 95 per cent. of the cases.

During normal and dyspneic respiration of primary pneumonic plague patients, plague bacilli are not usually expelled by means of the ex-

pired air. During the coughing of such patients, even when sputum visible to the naked eye is not expelled, plague bacilli in large numbers may become widely disseminated into the air surrounding the patient. Strong and Teague (Jour. Amer. Med. Assoc., Oct. 14, 1911).

Pneumonic and bubonic plagues are not identical; pneumonic plague is not epidemic in hot countries and is particularly virulent during severe winters. On the other hand, the bubonic plague has always raged from April to December, as in 1343 in France; 1603, 1605, 1625, 1636, 1665 in London; 1720 in Marseilles, 1770 in Moscow, and 1899 in Oporto; in fact, it prevails during the season in which fleas are most active. Manaud (Presse méd., July 26, 1911).

Epidemics of pneumonic plague occur in winter and those of bubonic form are found in summer. Epidemic pneumonic plague does not appear to be known in warm climates. This is probably because the bacilli of pneumonic plague are highly virulent and are spread by means of human contagion without the intervention of the rat, while in the summer time, when the insect carriers of the disease are able to infect the rat population, inoculation on the skin producing buboes is the most likely mode of infection and the epidemics of summer and of warm countries exhibit the bubonic type.

In view of these facts, during the summer and in hot climates the prophylactic measure chiefly to be employed is the **destruction of rats and their infesting parasites**, human contagion playing an insignificant rôle, while in winter **quarantine and isolation** must receive greater attention. Broca (Presse méd., July 26, 1911).

Pulmonary bubonic plague is an independent purulent inflammation in which the blood and lymphatics are loaded with the plague bacilli. The plague bacilli may enter in some cases by way of the mouth, causing specific

infection of the tonsils, or by way of the mucous membrane of the upper respiratory passages. The lungs in these cases are affected secondarily, either through the blood or through a descending bronchitis. Kulesh (Roussky Vrach, April 14, 1912).

In the *septicemic* form, which is characterized by intense infection, the fever is not high, owing to the correspondingly great depression of all functions. The other symptoms described occur in rapid succession, the patient dying, however, before even the lymph-nodes have had time to become perceptibly enlarged. This variety of plague is almost universally fatal.

The *cellulocutaneous* form resembles, in its general manifestations, bubonic plague; but there occurs besides inflammation and necrosis of the cutaneous and subcutaneous tissues, with spreading. A line of demarcation is sometimes formed and a sphacelus eliminated.

In *Pestis minor* or *ambulans*, the morbid process is milder, with swelling and sometimes suppuration of the lymph-nodes and a slight elevation of the temperature during a few days. The patient, in a large proportion of cases, can and does go about—a source of danger to others; for, though mild, this form is also very infectious.

A young man was kept under surveillance at Tripoli because he had been living with another who had developed the cutaneous form of bubonic plague. The first young man was apparently healthy, but the lymph-nodes in the groin and axillæ were enlarged on both sides. Puncture of one of the lymph-nodes in the groin revealed plague bacilli. He was evidently a healthy bacillus-carrier. A. Ilvento and M. Mazzitelli (Riforma medica, March 28, 1914).

DIAGNOSIS.—The sudden exhaustion and weakness at the commencement of the disease are characteristic; no other fever, especially on the first day, is characterized by such extreme debility. Neither is the moist, non-tremulous, mother-of-pearl-like tongue of Bulard met with in any other disease.

The possibility of *Bacillus pestis* infection should always be considered in a case of sudden marked prostration, with severe headache, vomiting, fever, early delirium, and a focus of lymphatic enlargement and tenderness. The diagnosis cannot, however, as a rule be made positively without a bacteriological study. This should be carried out with material secured by gland aspiration, smears of which usually show numerous typical bacilli. The characteristic growth of the organism on various media and certain peculiarities of behavior in cultures render the diagnosis so certain that the death of guinea-pigs inoculated with gland material is merely confirmatory. Wade and Staring (Amer. Jour. Trop. Dis., Oct., 1914).

The typical symptoms, the bubo, examination of the fluid in the latter and of the sputum for the plague bacillus in the pneumonic form, examination of the blood for bacilli, can hardly mislead.

In a suspicious case careful and continuous observation of the superficial lymphatic glands should be maintained, and puncture with the needle and examination of aspirated fluid made by smears and culture methods. The early identification beyond any doubt of bubonic plague depends upon the microscope. It is the duty of the attending physician to submit to the bacteriological laboratory slides made from the fluid aspirated from every suspicious bubo, and from sputum in every case of pneumonia showing more than ordi-

nary depression at the outset with a bright-red sputum instead of the typical rusty sputum of ordinary pneumonia. The services of the public bacteriologist should be available. J. B. Guthrie (N. Y. Med. Jour., April 5, 1913).

The specific organisms have been shown by Kitasato to persist in the blood for three or four weeks after the onset of the disease. Examination of the blood, however, may be fallacious, owing to variability of the bacillus, leading to confusion with other forms. The best confirmatory evidence is the result of a broth or agar cultivation. Inoculation experiments are also advisable, and, as the infection is often a mixed one, the animals used should have been previously subjected to "vaccination" against streptococci. A fair quantity of blood should be used and kept at a temperature of 37° C. (98.5° F.) for ten or twelve hours before being cultivated. The urine practically always contains albumin and plague bacilli, the latter often persisting for a week after convalescence.

In plague work, great care should be taken in handling infected animals, cultures, and other material. Even persons accustomed to bacteriological laboratory work had to be reminded of danger, as several cases of laboratory infection were on record. The principal things to look out for were fleas from animals, skin abrasions, soiling of fingers, use of pipettes, and smoking. R. L. Wilson (N. Y. Med. Jour., April 5, 1913).

Plague bacilli are found in long and short forms, with an intermediate stage. Their length appears to be inversely proportional to the nutritional value of the culture medium. The most characteristic appearance is that of sharply and repeatedly bent chains

of immobile spindle-shaped bacteria, almost as small as cocci. They are decolorized by Gram's method, and with weak solutions of staining reagents show a clear space in the center of the rod. The bacillus grows aërobically and anaërobically; it causes acid formation, but will grow in quite strongly alkaline solutions. It forms characteristic growths on agar and in bouillon.

The best culture medium is an alkaline solution of peptone containing 1 or 2 per cent. of gelatin. It is pathogenic to all the small laboratory animals with the exception of pigeons. The micro-organism is rapidly killed by drying at a temperature of 86° F. (30° C.) and upward, over concentrated sulphuric acid, but is much less affected by slow desiccation at lower temperatures. Even at the room temperature rapid drying is much more lethal to them than slow drying in tissues and fabrics.

For an early diagnosis of bubonic plague the most satisfactory method is that of aspiration of one of the recent swollen glands by means of a hypodermic syringe. With the material in the syringe: 1. A drop is used to make culture in melted agar tubes, or in bouillon from which dilutions, cultures, and plates can be made. 2. A drop is allowed to fall on a slide, which is then smeared by a platinum needle to be used for direct examination. 3. The remainder is injected into a mouse or a rat. If examination of the specimens on the glass slides shows the presence of large numbers of characteristic, short, bipolar-staining bacilli, that decolor by Gram's method, the case at once becomes more than suspicious. By the second day the inoculated animal is either dead or very ill, and an absolute diagnosis can be made. J. J. Curry (Boston Med. and Surg. Jour., March 21, 1901).

ETIOLOGY.—Small animals, monkeys, squirrels, rats, etc., die in great numbers during epidemics of plague, rats particularly—and they seem to be first to suffer.

Ceratophyllus fasciatus, the flea that infests the Eastern dog and marmot, can carry the pest bacillus unharmed in its intestine during forty-five days of a sort of hibernation that this insect undergoes. The infected flea gets packed into bundles of merchandise and crosses Siberia with caravans. Raybaud (Presse méd., Mar. 8, 1911).

Camels are not immune against plague, but are the chief cause of epidemics of this disease in some parts of southeastern Russia, among the Kirghiz tribes. The camel's meat is used as food by these people, especially when the animal gets sick, and it is thus a frequent cause of epidemics. Camel skins are used for various purposes. Klodnitzky (Rous-sky Vrach, xiii, No. 18, 1914).

Bedbugs which have fed on a case of septicemic plague should be regarded as ambulant cultures of plague. A large proportion of the bugs infected with a given strain of *B. pestis* succumb in a few days, the time of survival having some relation to the dose of bacilli. If bugs died the final results were indistinguishable whether the initial dose were large or small. The majority of the survivors had entirely overcome their bacilli. Cornwall and Menon (Indian Jour. of Med. Research, July, 1917).

The bacillus of plague has been found in the soil and in the dust of houses inhabited by sufferers. This micro-organism once transported to a suitable soil may there flourish and form foci of infection.

The English have found it almost impossible to disinfect large stone buildings in Hong Kong, Singapore, Bombay, and Calcutta. Plague recurs in these buildings with terrifying frequency after everything has been done that science can devise.

The writer attributes this largely to bedbugs and fleas that are not destroyed by the disinfection and fumigation, and also to the fact that the soil itself becomes infected where the tropical sun does not get at it. He found that the disease was not transmitted nearly so much if every one was compelled to put on shoes and stockings. All of the soldiers used in quarantine duty, and who were in close contact with plague cases, were **compelled to wear shoes and stockings**, and not one contracted the disease. The author was always careful not to stoop too closely over a pneumonic case so as to **avoid** the **breath or coughing of the patient**, and also to **keep** his **leggings saturated with coal oil to keep the fleas away**. In the town of Petchaburi a great number of children died, and it was found on investigation that the rats having died; the fleas took up their habitat on the dogs, and the children, petting the dogs, suffered in proportion. C. S. Braddock (N. Y. Med. Jour., Aug. 31, 1912).

After the activity of the plague bacillus has reached a certain potency, through appropriate surroundings, human beings are assailed, as well as the lower animals, the latter succumbing first. The tissues most vulnerable to the Kitasato bacillus are the skin and the mucous membrane, especially when these are deprived of their protective covering. Yamagiwa found a wound of the surface in 1 out of every 7 cases examined. The next portal of invasion is believed by some to be the alimentary and respiratory tracts. Once beneath the surface, the bacillus is thought to penetrate the lymphatic system and thence to invade the system at large.

The plague bacillus, according to Noguchi, is not devitalized by a three weeks' exposure to a temperature of -11.2° F. (-24° C.). This bacillus

can develop slowly, but steadily, at a temperature of from 68° to 80.6° F. (20° to 27° C.). Near the freezing point it remains inert. Chinese houses, with their bad ventilation and other unhygienic conditions, furnish favorable conditions for the development of the plague bacillus.

Although all classes suffer, certain conditions of life appear to confer immunity. Persons living indoors are more likely to suffer than those who are often exposed to the sun's rays. The boating population of China, who live exclusively upon the water, seldom suffer. Persons who occupy the upper stories of a dwelling are less frequently attacked than those living upon the ground floor. The infection may be transmitted by means of body linen, clothes, bedding, rags, bagging, carpets, etc. Food-stuffs, grain, sweetmeats, etc., are also thought capable, under suitable conditions, of transmitting infectious germs. Few nurses or attendants upon the sick are attacked if their habits are cleanly; even those whose duty includes the disinfection of infected dwellings have been free from the disease when personal cleanliness obtained. During the epidemic in Canton, in which upward of 30,000 Chinese died, not one of the 300 American or English residents, according to the China Medical Missionary, was affected.

The United States is confronted with an important problem, the solution of which should claim the attention of the whole country and impel it to immediate action—the danger of plague invasion. No longer is it endemic only in the Old World. It has made its appearance in Porto Rico and Cuba and has become a disease of universal distribution. H. D.

King (Jour. Amer. Med. Assoc., July 27, 1914).

PATHOLOGY.—In the buboes and the involved glands bacilli are found in enormous numbers, both among the cells of the gland-tissue and among the lymphatic vessels and the blood-corpuscles extravasated into the gland, as well as in the hemorrhage outside the gland. In cases of plague septicemia they are similarly present in the large characteristic glands. In the kidney the bacilli can also be seen, especially among the blood-cells of the tubules into which hemorrhage has occurred. In the spleen they are also present, among the cells of the splenic tissue and in the hemorrhagic areas. They are found in the liver, especially in cases in which engorgement and hemorrhage were marked. The bacilli are present in the pneumonic areas of plague pneumonia, in profusion among the catarrhal epithelial cells and leucocytes that fill the alveoli and terminal bronchioles, as well as among the blood-corpuscles of the alveoli into which hemorrhages occurred.

The writers' study of the human lesions, and those produced experimentally in animals, showed that epidemic plague pneumonia results from inhalation, the primary point of infection being the bronchi. Along the bronchioles the infection extends by continuity directly into the infundibulum and air-cells, or by contiguity through the walls of the bronchioles to the contiguous tissue of the lung, and gives rise to a consecutive peribronchial inflammation in the tissues immediately surrounding the bronchioles. From these areas the infection rapidly spreads to the adjacent pulmonary tissue and visceral pleura. The bacilli rapidly multiply and produce at first pneumonic changes of the lobular type, and shortly afterward

from the fusion of several rapidly spreading areas more general lobar involvement of the lung-tissue. The blood becomes quickly infected and a true bacteremia results in every case. Secondary pathological changes occur, particularly in the spleen, bronchial glands, heart, blood-vessels, kidneys, and liver. Strong, Crowell, and Teague (Philippine Jour. of Sci., June, 1912).

TREATMENT.—The medicinal treatment of plague, judging from the great mortality of that disease—80 to 90 per cent.—does not seem to merit much confidence. **Calomel** was largely used: an index of its general worth. Cantlie states that this agent should be given in from 5- to 10- grain (0.3 to 0.6 Gm.) doses, and be followed by a **saline** in some five hours' time.

From the very onset, or certainly after twenty-four or forty-eight hours, it will be found necessary to stimulate the patient by food, **alcohol** or medicine. **Food** should be given in small quantities, frequently repeated, and of a kind which is easily digested. Essence of beef, in fluid or jelly form, is recommended. Ox-tail soup, mutton-broth, beef-tea, and chicken-tea are also useful. Milk with ice, sipped slowly, and ice-cream are particularly grateful.

Thirst is a marked symptom, and **ice to suck**, if not kept up too long, water or **lemon and water** (not lemonade) to drink, **iced beer and stout**, **brandy**, or **whisky** diluted with three or four times its quantity of water (not aerated waters) may all be used.

When the pulse shows signs of failing or collapse or faintness supervenes, **alcohol** is beneficial, and **brandy** is preferable to whisky. Active delirium may be controlled by

cold to the head: **Leiter's coils**, **ice-bag**, or **wet cloth**. **Hyoscine** in $\frac{1}{100}$ -grain (0.00065 Gm.) dose hypodermically is the most efficient and safe of the hypnotics. **Morphine**, in $\frac{1}{8}$ -to $\frac{1}{4}$ -grain (0.008 to 0.016 Gm.) dose subcutaneously **with atropine**, is most useful when painful adenitis complicates the cerebral intoxication.

Diarrhea may be treated by **salol** in 10-grain (0.6 Gm.) doses or by a **suppository of morphine**, $\frac{1}{4}$ grain (0.016 Gm.); and **cocaine**, $\frac{1}{2}$ grain (0.03 Gm.). Vomiting may be controlled by a **mustard-plaster** to the **epigastrium**, **ice to suck**, and an effervescent draught of a few drops of **hydrocyanic acid** and solution of **morphine**.

For pyrexia, chemical antipyretics should not be used. Frequent **sponging with tepid water**, **ice to the head and nape of the neck**, **iced drinks**, and a short application of the **wet pack**, with the administration of **brandy** by the mouth or rectum. **Smelling-salts** and **strong ammonia** to the nostrils often arouse a patient in collapse and permanently revive those apparently moribund. Hypodermic injections of **ether** must be used frequently and freely. Internally, **ammonium carbonate** in a tincture or decoction of **cinchona** is most useful, while **digitalis** and **strophanthus** are unsatisfactory. **Camphor**, either hypodermically in sterilized oil or as a 2-grain (0.13 Gm.) pill, is a direct stimulant and a stomachic carminative. **Musk** may be given in 5-grain (0.3 Gm.) doses every six hours. **Strychnine sulphate** in $\frac{1}{48}$ -grain (0.0013 Gm.) dose hypodermically in 10 minims (0.6 c.c.) of distilled water is valuable. **Inhalations of oxygen** are also recommended. **Abscesses** should be opened when they point.

The writer gave **adrenalin chloride** a trial. On the administration of the drug in the first few cases in which it was tried, the results were sufficiently satisfactory to insure that all future patients admitted during the outbreak should be treated in the same manner. For adults 31-minim (2 c.c.) doses of adrenalin chloride of a strength of 1:1000 were at first usually given by the mouth, with 10 minims (0.6 c.c.) of **tincture of strophanthus** every four hours for the first three days and three times a day thereafter for approximately another fourteen days. Later, especially if the patient was extremely ill on admission, it was usual for the adrenalin to be given hypodermically or intravenously, in somewhat similar doses until the patient was out of danger, when it was given, as in the earlier cases, by the mouth. The mixture for oral administration was made up as required, for it does not keep.

The hospital mortality from bubonic plague (excluding septicemic cases) in those patients not treated with adrenalin has been 37.4 per cent., or, excluding Asiatics, 35.9 per cent., as compared with a mortality of 26 per cent., only among those treated with adrenalin. Thornton (*Lancet*, April 9, 1910).

Experiences with **carbolic acid**, given in large doses—12 grains (0.7 Gm.) every two hours, or 144 grains (9.3 Gm.) daily. If the drug was pure, carboloria rarely occurred, and when it did all that was necessary was to intermit a few doses. The writer has treated a series of 143 patients in this way, with a mortality of 30 per cent. Thomson (*Med. Press and Circular*, Jan. 18, 1911).

Early **crucial incision into the swollen glands** employed in 62 cases, with 54 recoveries. Causes immediate improvement in patient's condition, temperature being lowered and headache alleviated. Wounds dressed with **iodine** lotion, 1 dram to the ounce (4 c.c. to 30 c.c.) of water. Nesfield (*Lancet*, Nov. 4, 1911).

Serotherapy.—Serotherapy, though by no means a specific, seems undoubtedly to reduce the death rate. **Yersin's serum** is said to have reduced the mortality of severe cases from 90 to 50 per cent. and that of mild cases from 50 to 10 per cent. This serum is prepared as follows: The subcutaneous injection into horses of a fresh plague-bacillus culture upon agar, giving rise to a severe local swelling, ephemeral fever, and an abscess, Yersin resorts to venous inoculation, and thus avoids the abscess formation. Violent reaction follows these injections until, after repeated and stronger doses, immunization is accomplished. Three weeks after the last injection a serum is obtained by venesection that may be used therapeutically. It is important to remember, however, that this serum does not long retain its activity.

Only 4 recovered out of 163 patients with bubonic plague treated by the ordinary medical measures alone, and in these 4 the suppurating bubo opened spontaneously. In 82 cases in which the bubo was enucleated or merely incised, 57 recovered, 28 of the 57 with **enucleation** and 25 with **incision** alone. Only 9 recovered out of 89 patients treated with **serotherapy** alone, but serotherapy supplemented by incision as soon as there was fluctuation in the bubo was followed by recovery in 78.1 per cent. of the 32 patients treated in this way, and by recovery of 31.2 per cent. of the 32 treated by serotherapy and enucleation. **Japanese antiplague serum** was used, and in large doses. Masuyama (*Zeit. f. klin. Med.*, lxx, Nos. 5, 6, 1910).

Cases in which serum used was that known as "**dry serum**" made by the Pasteur Institute. This is far superior to the liquid serum which is perhaps responsible for the poor results reported by some observers.

The dry serum is difficult to dissolve if one is not familiar with it. The main point is to have a test-tube with just sufficient water to moisten its sides. The dry serum is dropped from the glass capsule in which it comes so that the particles which adhere readily are only one deep on the sides of the tube. Then add sufficient water to make the necessary 10 c.c. (2½ drams). Heat should never be employed. In all cases treated within forty-eight hours of its inception among the 20 cases occurring, the serum acted favorably. A. N. Sinclair (*Jour. Amer. Med. Assoc.*, Feb. 4, 1911).

In India, taking selected cases, the mortality had been reduced from 74 to 63 per cent. by the use of the **Yersin and Roux serum**, and in private cases to 40 per cent. **Haffkine's prophylactic** is of great value and should be given to nurses and contacts; it prevents the disease, even if given during the inoculation period. The third line of specific treatment is by **organotherapy**. **Epinephrin** is said to have reduced the mortality to 37 per cent. in a reported series of cases, and the success was enough to warrant further trial. Thomson (*Med. Press and Circular*, Jan. 18, 1911).

The writer injects from 90 to 100 c.c. (3 to 3½ ounces) of serum in adults—½ intravenously and ½ subcutaneously in the region of the bubo. (In children, about half this amount.) Of late he has, in addition, adopted the plan of injecting pure **phenol** into the enlarged gland or glands—from 10 to 20 drops (presumably of a saturated solution) for each patient. Also, he gives **hexamethylenamine** to its limit, *i.e.*, until the patient complains of considerable irritation of the bladder. Two cases recently treated with hexamethylenamine and phenol injections (without the use of serum) have recovered. P. J. Todd (*China Med. Jour.*, May, 1913).

PROPHYLAXIS.—When plague prevails, the **extermination of rats**

is of primary importance; the methods of doing so which have proved most efficacious are traps and poisons. During the illness, the **disinfection** required is very much the same as in a case of typhoid. Nurses should be warned of the possibility of infection through an abrasion of the skin, and any **abrasions** present ought to be **protected by collodion**.

There are 3 methods all of which must be pursued in order to attain **rat extermination**. These in the order of their importance, although not of period of adoption, are:—

1. The destruction of the nests.
2. The deprivation of food.
3. The killing of the rats themselves.

In the immediate presence of an epidemic, the last named should take the precedence. The means for this are traps and poisons.

Rats can be deprived of much food by strictly covering up every particle of refuse matter, protecting chickens and pigeons from their attacks and rat-proofing granaries and store-houses of all kinds.

Their nests can be broken up by tearing up floors, passage-ways, cellars, piles of rubbish, lumber, scrap-iron and other refuges, and destroying old, deserted buildings and shacks, followed by the free use of cement or concrete to render the basements, cellars, and walls of all buildings absolutely rat-proof. Strong galvanized-wire netting of one-half-inch mesh is also an effective obstacle to their entrance. With the disappearance of rats, rat-fleas also vanish from a community.

The rat can be, to use an expressive recent phrase, "built out of existence," as is being done in San Francisco, but only a few people have sufficient intelligence and public spirit to do their part in this movement except under compulsion. Therefore we must have laws governing the careless harboring of the rat.

A city garbage dump always affords

food for rats and on that account alone should never be allowed to exist. Garbage incinerators should be universally established. (Penna. Depart. of Health Bull., May, 1910).

Since plague is a disease of commerce and likewise a disease of rats, and since rats travel the world over in ships, it is incumbent on those who are charged with the protection of the health of marine ports to **kill rats in ships**. Periodical fumigation is recommended, by **sulphur dioxide, carbon dioxide, carbon monoxide, or funnel gases**. An international agreement is suggested. Rucker (Jour. Amer. Med. Assoc., July 27, 1912).

In the recent epidemic of human plague in Porto Rico, 55 cases, all of the bubonic type, were recorded, with a mortality of 65 per cent. Although flea infestation was very low, the infestation of rats by the chicken flea in San Juan is noteworthy. R. H. Creel (Jour. Amer. Med. Assoc., May 17, 1913).

Some writers have reported negative results but the writer's examination of 2111 field rats showed fleas on 565, and that more than half of the fleas were of the cheopis species. He found also that the field rats get this flea from the house rats, but that this species dies off out of doors when inclement weather arrives. Otten (Meded. v. d. Burg. Geneesk. Dienst of Batavia 6, 1917).

The occurrence of plague being favored by the absence of sunshine and general insanitary conditions, such as obstruction to the free access of light and air to domestic dwellings, the steps to be taken to retard the progress of the disease are: (a) **general cleanliness and the free admission of light and air to domestic dwellings**; (b) **the immediate isolation of the sick and those who have been in close contact with the disease**; (c) **the careful and systematic disinfection of all premises in which cases occur, and of latrines**.

The belief that infection of doctors, nurses, attendants, etc., in plague hospitals is caused only by large or visible particles of sputum expectorated by the patient, is erroneous. It follows that the **wearing of masks** and the proper **covering of** any surface of the skin where fresh **abrasions** are present are important personal prophylactic measures in pneumonic plague. It also follows that the **eyes** should be **protected** against this manner of conjunctival infection by proper **glasses**. Articles of **clothing worn** in the wards should immediately be **sterilized after removal**, since, even though no particles of sputum may be visible on them, plague bacilli may be present.

As to the best methods of **disinfection**, moist heat—*i.e.*, **steam**—was the most efficacious. Of chemical reagents, the best were 1:1000 **sublimite** in **carbol-sulphuric acid**, **lysol**, and **chloride of lime** in 1 per cent. solution. Carbolic acid proved useless in less than 5 per cent. strength.

Active Immunity.—Several methods of producing active immunity have been proposed. **Haffkine**, working in India, in 1907, proposed his well-known **prophylactic**. This consists of a bouillon culture of the pest bacilli, killed by heat and carbolized so as to represent a 0.5 per cent. solution of phenol. The dose of this varies from $7\frac{1}{2}$ to 15 minims (0.5 to 1 c.c.), and in special cases as much as 5 drams (20 c.c.) were given. The reaction varies greatly in different individuals; as a rule, there are slight fever, malaise with local swelling, and edema for twenty-four or forty-eight hours. Ten days later, a second, larger dose may be given, the size varying according to the reaction

following the first dose. The protection afforded by the prophylactic is not absolute.

When repeated several times it affords a relative immunity for some months. From 4 to 20 per cent. of the inoculated contract the disease, and from 2 to 8 per cent. die. Passive immunization by means of **sera** derived from animals in whom an artificial immunity has been created, has been used prophylactically and therapeutically. The immunity produced by immune sera is said to last but a few days.

Yersin's serum renders a person immune for three months and acts within twenty-four hours. When inoculation is given in the incubation stage of the disease, that is, before signs of plague appear, it has in many cases the power to abort the disease. Inoculation has no effect on other diseases, except possibly eczema, which appears to be benefited by it. It confers a high degree of immunity and greatly reduces the number of plague attacks. When, in spite of inoculation, a person is attacked, his chances of recovery are greatly increased. B. R. Slaughter (Johns Hopkins Hospital Bull., Nov., 1903).

In India, in 1900, **Haffkine's prophylactic vaccine** gave excellent results. Of 1300 people inoculated, 5 developed plague, of whom only 1 died; 12 refused inoculation, and of these 6 contracted the disease and 3 died. Of another series of 5640 persons, only 45 were inoculated, and none of them contracted the disease. Of the remaining 5595 (uninoculated) 383 subsequently had the disease and 260 died. The vaccine, consisting of a culture of the plague bacillus killed by heat, to which a minute quantity of carbolic acid had been added, was supplied in sealed glass tubes. The dose, varying from 0.2 c.c. to 0.5 c.c., was given subcutaneously at one sitting, except in pregnant women, who received 2 divided doses. Glass

syringes, sterilized by the oil method, were used. The site of injection was the center of the posterior surface of the upper arm. Abscesses developed in 6 out of 1300 cases, although all antiseptic precautions were observed. Lucas (Brit. Med. Jour., April 20, 1907).

At the international conference at Mukden regarding means of vaccination and therapy in the bubonic plague, it was agreed that while it is clearly proved that **vaccination** is an efficacious means of defence against the bubonic form of the disease, it cannot be said that it is effective in the case of the pulmonary form of the disease. Signorelli (Lo Sperimentale, Feb., 1912).

Among their 14 cases there were only 6 deaths, **serum** having been used in large doses. The cases embraced the bubonic and septicemic forms, and in 1 case meningitis was a complication. Of the 6 patients who died, only 2 received serum treatment, 1 receiving only 1 injection. Patients with axillary buboes should be given much larger initial doses. Levy and McMicken (Texas State Jour. of Med., Sept., 1920).

While **vaccine** is probably of some value, it is not capable of controlling an outbreak of plague. The evidence on the prophylactic value of serum is not conclusive and the agent need not be seriously considered in this connection. The therapeutic use of serum is usually advantageous but brilliant results are seldom witnessed. McCoy and Chapin (Public Health Reports, XXXV, No. 28, 1647, 1920).

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PLEURA, DISEASES OF THE.
—PLEURITIS (PLEURISY).—Inflammation of the pleura, as a *primary* affection, occurs, though rarely. In most cases, met with, pleuritis is *secondary* to a general or local disease.

Acute pleuritis occurs in the following forms: *Fibrinous*, *serofibrinous*,

seropurulent, *purulent*, *hemorrhagic*,—according to the nature of the pathological process. The following varieties, based on other peculiarities of the disease, are also recognized: *Pulsating*, *interlobar*, and *diaphragmatic*. The purulent form of pleuritis will be discussed under CHRONIC PLEURITIS.

ACUTE PLEURITIS.

SYMPTOMS.—When the disease occurs secondarily to some grave disease whose symptoms mask those of the pleurisy, and when it occurs late in such exhausting diseases as carcinoma, nephritis, and tuberculosis, acute pleuritis may be virtually in abeyance, or at least be characterized by a very insidious onset.

In most instances, however, an attack of pleurisy sets in with slight shivering followed by fever and pain in the side. Headache, malaise, and anorexia are usually complained of. In some cases there is an abrupt chill, especially in pneumococcal pleurisy, which may closely simulate pneumonia. In children the chill is usually replaced by vomiting, sometimes by a convulsion.

Severe, stabbing pain is the most distressing and constant symptom; it usually occurs in the neighborhood of the nipple or in the axillary region. It is apt to be sudden after exposure to traumatism or when the disease develops in the course of pulmonary tuberculosis. The pain may, however, be referred to the back or to any part of the abdomen. So severe and circumscribed has it been in the abdomen that a diagnosis of appendicitis has been made and an operation performed. The pain ordinarily is sharp and excruciating, aggravated by respiratory movements and cough. It may occur at the site of the inflammatory process or where the areas of pulmonary expan-

sion are greatest. It may also follow the distribution of the intercostal nerves in the lower thorax and upper surface of the abdomen. In severe cases there is marked tenderness over their course. In some cases the intercostal are also involved. The pain is aggravated by cough, breathing, change of posture, and pressure. It is usually relieved when the serous effusion becomes sufficient to separate the pleural surfaces—usually the fourth to the seventh day.

In dry pleurisy the pain is increased when the patient bends his body toward the well side, whereas in intercostal neuralgia the pain is increased by bending the body toward the affected side. Sternberg considers a sensitiveness to palpation of the muscles of the shoulder-girdle a valuable diagnostic sign. Schepelmann (*Berl. klin. Woch.*, Nu. 24, 1911).

The writer noted marked isolated shoulder-pain in pleurisy in 4 cases. Every one had a basal pleurisy. At some time or other the patient complained of pain in the region of the diaphragm; three times the phrenic nerve was sensitive to pressure. Gerhardt (*Münch. med. Woch.*, Dec. 30, 1913).

In 30 out of 53 cases of apical pleuritis auscultation showed that the lesions were exclusively or predominantly restricted to the left apex. The condition, whether of tuberculous origin or not, has a favorable prognosis. Roubier (*Revue de Méd.*, Nov.-Dec., 1919).

Hard and dry cough is an early symptom, being worse usually in the early stage. It is occasionally attended by slight expectoration of mucus, owing to the associated bronchitis. As it increases the pain, it is repressed as much as possible. Breathing is, as a rule, superficial and rapid owing to the pain caused by deep and slow inspirations. The temperature for the first week or ten days rarely rises above 101°

or 102° F. (38.5° or 38.9° C.); in the pneumonic type it may be as high as in pneumonia, with an incomplete crisis followed by a second rise. It generally, however, declines by lysis in about ten days, but the fever may persist for weeks, taking on a hectic character, even in serofibrinous cases, suggestive of suppurative exudation. Such cases are probably tuberculous. Exacerbations of the febrile process are not uncommon. Some cases are unattended by appreciable fever.

The pulse is moderately quickened. The pulse-respiration ratio does not undergo the marked change so characteristic of pneumonia. The respiration is also increased on account of the pain and later owing to the bulk of the exudate. The effect of the effusion on the respiration depends much on the rapidity of its accumulation,—a rapid exudation, which may vary from 200 c.c. in the child to 800 c.c. or more in the adult, causing much dyspnea, cyanosis, frequency, and smallness of the pulse, while one slowly formed may produce no conscious disturbance so long as the patient is quiet, although the pleural cavity may be moderately distended. In the early stage the decubitus varies, but when the effusion becomes copious the patient usually lies on the affected side.

PHYSICAL SIGNS.—A sudden “stitch in the side” and fever suggest pleurisy, but a diagnosis is not easy without a study of the physical signs. These depend chiefly on the nature and amount of the exudation. During the first stage, usually termed the “dry” stage, though characterized anatomically by the presence of an exudate on the pleural surface, the movements of the affected side are restrained on account of the pain, the expansion being

somewhat jerky. The patient often lies on the healthy side to avoid pressure on the affected and thus decrease the pain, before effusion has occurred or when it is slight; when it is large, however, he usually lies on the diseased side to allow free expansion of the chest on the unaffected side. When effusion has occurred, the affected side is enlarged, the costal interspaces bulging. The respiratory movements of the chest and also those of the diaphragm on the side of the effusion are restrained or arrested. Fluoroscopic examination shows this plainly. Owing to lessened expansion of the lung and the considerable amount of plastic exudation, there may be somewhat diminished resonance.

Palpation elicits, in this stage, a fremitus, due to friction of the pleural surfaces. Percussion is as a rule negative, though it may reveal an unusual degree of sensitiveness of the tissues over the affected region. On auscultation the breath-sounds are weak or even absent. Friction-rub may be heard and is the diagnostic sign. When well defined it is heard as a to-and-fro sound in inspiration and expiration. It may be heard in deep inspiration only. Usually in children and not rarely in adults it is absent. It may be heard only over small areas,—in the inframammary or axillary region,—and is therefore liable to be overlooked. It consists of a succession of superficial creaking or rubbing sounds, but may resemble a crackling râle. It lasts but a few hours in cases of rapid effusion. In pleurisy in the neighborhood of the heart a friction-sound of cardiac rhythm may simulate pericardial friction. The inflammatory process may undergo resolution at this time or proceed to the stage of effusion.

The physical signs of the stage of effusion vary with the volume of fluid which the pleural cavity contains. If the effusion separates the pleural surfaces the pain is relieved and the chest-movements become more free. If the effusion is slight, there may be no sign or the level of the fluid may be detected, the patient sitting up, by a vesiculotympany beginning with that level. As the fluid increases in quantity the intercostal depressions become widened and obliterated, giving the chest a smooth, rounded appearance with increase of the anteroposterior diameter. The chest movements are then lessened both transversely and vertically. In large effusions the mediastinum is displaced toward the sound side, especially so in effusions into the left pleura. The position of the cardiac impulse is an excellent index of the degree of mediastinal displacement, and therefore of the amount of pleural effusion. It may appear at the left axillary line or as far to the right as the right mammary line. The downward displacement of the diaphragm is measured by the position of the liver and spleen, the lower borders of which may be at or below the umbilical line.

Palpation at this stage elicits diminution of the vocal fremitus over the effusion, but an important sign of the latter is the flat note and the increased, or "board-like," resistance over the whole area of the effusion. This loss of resonance and elasticity is due chiefly to the liquid in the pleural cavity, but partly also to the collapsed state of the lung beneath the fluid. The dullness extends from the base upward, being usually higher behind than in front.

The spinalis-muscle sign of pleurisy is analogous to the rigidity of the abdominal walls in case of trouble be-

low. There is a reflex contraction of the spinalis muscle tending to immobilize the diseased thorax and pleura. As the patient stands perfectly straight, the contracted muscle forms a prominent mass, hard and larger than the normal outline of the muscle. This occurs, in other conditions, but these can be easily excluded when examining for pleurisy. The spinalis muscles are liable to be unusually developed in porters or in case of much lordosis and the sign may accompany kidney and liver disease, peritonitis, etc. Ramond (*Presse méd.*, May 15, 1913).

When the effusion rises higher than the angle of the scapula the lung will have relaxed to such a degree as to give a tympanitic note above the nipple: the skodaic resonance. Posteriorly the note is usually somewhat impaired far up the back. The level of the fluid is usually altered by a change of position of the patient. On this point, however, different observers report different results. Possibly in moderate effusions the fluid changes gradually with change of position of the patient if there are no adhesions. In some cases, in which the effusion has formed in the recumbent position, the area of flatness corresponds with the surface of the lower lobe of the lung; but in some of these the exudate is almost wholly fibrinous. The lower limit of flatness on the right side passes into and cannot be distinguished from liver-dullness; on the left extends to and, in large effusions, it obliterates stomach-resonance: Traube's semilunar space (McPhedran). Ellis has called attention to an S-like curve in the line of demarcation which he regards as characteristic. When the effusion is sufficient to fill the pleural cavity, no change of level can be detected by changing the patient's position. The

skodaic resonance and, sometimes, the "cracked pot" sound are discernible.

In the diagnosis by X-ray, the location of fluid in serofibrinous pleurisy depends upon the position assumed most constantly by patient during acute stage, and exudates of this type are but slightly, if at all, mobile. These facts are of assistance in the differentiation of serofibrinous from other varieties of effusion. Engelbach and Carman (*Amer. Jour. Med. Sci.*, Dec., 1911).

The writer urges the importance of percussion in the axilla and infra-axillary region for the early recognition of certain pleural disorders. From experience in over 1000 cases, he asserts that, given posterior thoracic dullness, axillary or even infra-axillary dullness should direct attention to the possibility of an effusion or adhesive process in the pleura. In acute or subacute chest affections, dullness in the axilla, *i.e.*, above the transverse nipple line, indicates in over three-fourths of all cases the presence of fluid, especially when the level of axillary dullness is higher than that posteriorly.

Infra-axillary dullness alone indicates, under similar conditions, the presence of fluid in about one-half of all cases.

Observing axillary dullness should always incite the practitioner to the performance of exploratory puncture which, by revealing effusion early, permits of prompt surgical treatment where infection exists. The puncture should be done first in the posterior dull area, then in the axillary and infra-axillary area. G. Mouriquand (*Presse médicale*, March 24, 1919).

Auscultation reveals almost inaudible breathing sounds, though vocal resonance may be normal. Curiously enough, as shown by Baccelli, the whispered voice is transmitted through a serous effusion, but not when it is an accumulation of pus. As the exudation increases, vocal thrill is at first weak-

ened and finally lost over the area of dullness. In rare cases it remains unaffected, especially in children. This may be due to conduction of vibration from the spine along the ribs.

The respiratory sounds are weak or absent below the level of the exudate, but often in children and occasionally in adults tubular breathing is audible all over the dull area, especially if the pleural cavity is so full as to collapse the lung, but not to compress the bronchi. Only a puffing expiration of amphoric quality may be present, or the breath-sounds may be intensely amphoric or cavernous and may lead to a diagnosis of cavity, or pneumothorax.

When the effusion is very large, filling, perhaps, three-fourths of the chest, the resistance to pressure is very marked, the chest movements are still more hampered, and the intercostal spaces may bulge out. The heart is greatly displaced far to the right if the fluid is in the left sac, but it is displaced to the left if the effusion is in the right sac; its sounds, however, are but little, if at all, altered. The vocal fremitus is absent. The percussion note is very flat and skodaic resonance cannot be obtained.

The Koranyi-Grocco sign, a paravertebral triangular area of dullness on the side appropriate to that of the effusion (described and illustrated in the article on the CHEST, SURGICAL DISORDERS OF, *q. v.*) due to extension of the effusion across the vertebral column, is found in practically every case, and disappears on removal of the fluid.

Grocco, in 1902, demonstrated in exudative pleurisy the presence of a relative dullness in a triangular area situated over the back, near the vertebra, on the normal side. Conto demonstrated later that this dullness was

not only to be found in fluid effusions of the pleura, but also in fibrous pneumonia, and even in tumors of the spleen. The writer reports one case of exudative pleurisy in which he could demonstrate Grocco's sign. Barros (*Presse méd.*, April 3, 1909).

Presence of the latter may also be detected by means of the coin sign. This is obtained by laying a coin on the front of the chest and striking it with another; the ear placed at the back of the chest has transmitted to it in some cases a clear metallic sound, if a pleural effusion is present.

The Pitres coin sign tried in 25 cases of pneumonia and pleurisy in children, and found of great value. In uncomplicated pleuritic effusion the metallic sound was always transmitted through the affected area. S. E. Ostrovsky (*Roussy Vrach*, May 4, 1913).

Time has demonstrated the value of the coin sign for the detection of pleural effusion. Lereboullet (*Paris Medical*, Jan. 5, 1918).

Exploring the chest with the aspirator affords a positive means of determining the existence of fluid and its character. If the needle is strictly aseptic and the surface of the chest carefully disinfected, aspiration may be resorted to with impunity. Certain errors have to be guarded against. The exudate may be encapsulated and the needle pass to one side of the cavity. The pus may be too thick to enter a needle unless it is of large caliber; a large needle should, as a rule, be used; it causes but little more distress than a small one. When even a large needle is plugged by the false membrane in piercing it, suction should be cut off and the needle withdrawn, when the plug of purulent fibrin will be found in the needle and confirm the diagnosis. The needle may enter a purulent cavity in the lung re-

sulting from tuberculosis, pneumonia, actinomycosis, a subphrenic abscess, a purulent pericardial exudate, etc.

In this connection a number of complicating conditions or varieties of pleurisy must be borne in mind lest they more or less suddenly modify the clinical picture. They are as follows:—

Tubercular pleurisy, due to invasion of the pleura by the tubercle bacillus in the course of pulmonary tuberculosis, and strictly, therefore, a complication of the latter disease.

Pulsating pleurisy, a form which is practically always purulent. Its characteristic feature is the presence of a heaving pulsation which may be limited to the sternal region, or diffused and most marked in the axillary and scapular regions. In some of the cases the impulse does not occur until perforation of an intercostal space leads to the formation of an abscess-sac beneath the skin, the pulsation being confined to the subcutaneous abscess.

Interlobar pleurisy, in which the opposed surfaces of two lobes of lung adhere. Pus may form a sac between them, forming an abscess which may rupture into a bronchus. It gives rise to hectic fever, and is often the cause of the latter when it follows pneumonia. The X-rays have considerably facilitated the diagnosis of this condition. It is frequently confounded with gangrene of the lung.

Diaphragmatic pleurisy in which the diaphragmatic pleura is involved with the pulmonary pleura or is alone the seat of inflammation. As a rule it is dry, but it may be the seat of a serofibrinous or purulent exudation. It is very painful especially during deglutition and breathing, the patient being thus led to use the upper thorax during respiration. Of diagnostic importance is that

it gives rise to pain in the appendiceal region; also that pressure along the tenth rib where the diaphragm is inserted increases the local pain.

Diaphragmatic pleurisy is, in all probability, associated with involvement of the base of the lung. There are, however, cases in which no such involvement can be demonstrated. The distribution of the pain toward the abdomen may thus lead to a diagnosis of some acute disorder in the upper abdomen. The recognition of pain and tenderness in the neck region will materially help in the differential diagnosis. With inflammation of the central portion of the diaphragm, one may expect the pain to be referred to the region of the neck, while if the outer edge of the diaphragm be irritated the pain will be referred along the dorsal segments to the abdomen. Dexter (Cleveland Med. Jour., Feb., 1914).

Hemorrhagic pleurisy in which the pleural sac is invaded by blood is usually secondary to tuberculosis, cancer, wounds, tapping of the pleura, hemothorax due to rupture of an aneurism or of some local or neighboring vessel from any cause.

Pleurisy presents a very variable course. In the dry stage the inflammation may rapidly subside and recovery take place in a few days. Or, the pain may persist some time and fresh attacks develop in other parts of the pleura. In these the pleurisy is secondary to other affections, chiefly pulmonary tuberculosis.

When there is a serofibrinous effusion the fluid may increase for a week or ten days; the active process then ceases and absorption sets in, followed by a rapid recovery. Or absorption may not begin until after the lapse of a stationary period of indefinite duration.

Recovery is rarely complete in less than a month; when there is consider-

able effusion, recovery is greatly delayed, especially if aspiration is required. Absorption rarely begins during the continuance of the fever.

Even though serofibrinous pleurisy is seldom fatal, unless the effusion be excessive; it may persist for months, as in tuberculous cases, notwithstanding repeated aspirations. The effusion causes little discomfort while the patient is at rest, but when the accumulation is at all great, sudden death is liable to occur, especially on exertion. Death may also be caused by thrombosis or embolism of the pulmonary artery, clot in the right ventricle, degeneration of the heart, or edema of the uncompressed lung. Dullness, due to unexpanded lung or to copious fibrinous exudation, often persists after the effusion is absorbed. Local or general retraction of the chest sometimes follows absorption.

DIAGNOSIS.—Pleurisy with effusion may be mistaken for *pneumonia*, but if it is recalled that while in the latter disease there is increased vocal fremitus and resonance, these are decreased in pleurisy, and that in the latter the cough is slight while it is marked in pneumonia, confusion can hardly occur. The earliest symptoms of pleurisy may be latent, however, and thus render the diagnosis very difficult. In the acute dry stage the friction-rub, if present, greatly facilitates recognition of the disease; but if the rub is absent, *pleurodynia* and *intercostal neuralgia* suggest themselves. The presence of fever, however, eliminates these conditions. Careful examination should be made frequently over the area of pain, lest effusion occur and be overlooked.

When later the effusion is abundant, the diagnosis may also be difficult. The diagnosis should then be based upon the enlargement and immobility of the

chest, dullness with loss of elasticity over the dull area, absence of vocal thrill, weakness or absence of respiratory sounds, and the displacement of the cardiac impulse toward the unaffected side. Of these signs the cardiac displacement is the most important.

High-pitched tympanitic resonance below the clavicle is characteristic of fluid below. In moderate effusions these signs may be wanting or indefinite, and the case may closely simulate *pneumonia*. This history of initial chill, the rapid rise of temperature, the dyspnea, the rusty sputum, and the dullness without the wooden character usually serve to identify pneumonia. Again, while in the latter disease there is increased vocal fremitus and resonance, in pleurisy these are decreased. Again, cough is usually slight in the latter disease while in pneumonia it is severe.

Pleurisy in the dry stage may also be mistaken for *intercostal neuralgia*, *pericostitis* or *caries*, *gastric ulcer*, and *gastrodynia*, but the presence of fever and other signs serve to identify pleurisy. *Mediastinal tumors* may produce confusion; in the latter the signs are not limited to one side, while signs of pressure on the esophagus and other structures appear sooner or later.

In case of doubt as to the presence of effusion, X-ray examination should be resorted to. The rays are cut off by the dense fluid and the outline of the ribs may be obliterated. The fluoroscope is also helpful. In very obscure cases exploration of the suspected area with the aspirator, with extreme precautions to insure asepsis, may indicate the presence of fluid. Inequality of the pupils is sometimes observed.

A large *pericardial effusion* is sometimes difficult to distinguish from left-sided pleural effusion. But the cardiac

impulse is not displaced to the right in pericardial effusion; the heart is feeble and the impulse weak. In pleurisy the impulse is commonly easily felt unless it is behind the sternum and the heart-sounds are strong. In *large pericardial effusion* there are marked dyspnea and a peculiar cyanotic hue of the general surface.

In the left axilla the percussion-note is skodaic unless obscured by associated pleural effusion. In the latter case removal of the pleural effusion is not followed by due relief and the cardiac impulse is not affected. On the right side *subphrenic abscess* or *hydatid cyst of the liver* may force the diaphragm high in the thorax and be mistaken for pleural effusion. The upper limit of dullness is usually arched and in some cases a friction-rub is present over all parts of the tumor: a sign that should arouse suspicion. Then there are fullness and a feeling of tension in the hypochondrium; the liver is sometimes depressed, but it may be in pleural exudations also. *Hydrothorax* presents all the signs of pleural effusion, and intrathoracic tumors may simulate and often give rise to it (McPhedran).

An *aneurism* may be suggested by a pulsating empyema, but the hectic fever, sweats, leucocytosis, and other indications of the presence of pus and the absence of aneurismal thrill and pressure symptoms serve to identify the condition present.

ETIOLOGY.—Pleurisy may occur at any age including infancy, but males seem more subject to it than females, doubtless owing to the greater exposure to which they are subjected.

Exposure to cold and wet is a prolific cause, especially in debilitated subjects and in those who inherit a proclivity to tuberculous infection, cold

lowering the power of the body to resist pathogenic organisms.

Pleurisy is frequently awakened through extension of a neighboring inflammatory process of the lungs especially, but also in the mediastinum and pericardium. Traumatism and various acute or chronic diseases, such as septicemia, the acute fevers, including typhoid, acute rheumatism, Bright's disease, hepatic cirrhosis, cancer, the second stage of syphilis (Chantemesse); or, independently of any defined syndrome, by various pathogenic organisms, especially the pneumococcus, staphylococcus, and tubercle bacillus. The last is regarded as the most common pathogenic agent in dry pleurisy and in pleurisy with serous effusion.

The pneumococcic cases are frank, sthenic, and benign in tendency. Those due to staphylococci are more insidious and less frank in their symptomatology. The cases due to the typhoid bacillus occur in the course of typhoid fever, are latent in their symptomatology, and are often somewhat hemorrhagic. The tuberculous forms tend to be dry and fibrinous (Fernet).

PATHOLOGY.—The morbid process occurring in the pleura is initiated by hyperemia, and continued in proliferation and desquamation of endothelial cells, as well as in exudation of serum and leucocytes on the surface of the pleura. The pleura loses its polish, partly on account of these changes and partly because of coagulated fibrin from the exudated serum, which forms a thin layer on its surface. Agglutination and more or less permanent adhesion of the opposed areas of inflamed pleural surface take place, and at times this constitutes the sole evidence of the pleural inflammation, serous fluid being either not exuded or at once reabsorbed.

In the more severe cases of this type, the fibrin forms in thick, shaggy masses, of which the layers in contact with the pleura are more or less densely laminated. The fibrinous exudate usually forms more densely on the visceral pleura than the parietal because infection generally takes place from the lung.

When the inflammatory process ceases at this stage it is spoken of as a dry pleurisy (*pleuritis sicca*). The exudate is then partly absorbed and usually in part organized into fibrous tissue, permanent adhesions of the opposed pleural surfaces resulting. It is probable, however, by analogy with peritonitis, that in mild cases all the exudate is absorbed, leaving no adhesions or other traces of inflammation.

As a result of the study of 439 cases of pleurisy treated in the Boston City Hospital between 1880 and 1895, the writer concludes that about 10 per cent. of these cases are known to have developed tuberculosis. Over 55 per cent. of all the cases which were followed to their death died from some form of tuberculosis. Tuberculosis, when it occurred, developed within five years in over 50 per cent. and within ten years in over 70 per cent. The danger of evil consequences is much increased by a tuberculous family history or a personal history of some form of tuberculosis previous to the attack. G. G. Sears (Boston Med. & Surg. Jour., Feb. 25, 1904).

In the majority of cases, on the other hand, there is exuded, besides the fibrin, a more or less considerable amount of serous fluid containing fibrinous shreds. The fluid varies in quantity from a few drams to an amount sufficient greatly to distend the chest, *e.g.*, 4 quarts (liters). Unless circumscribed by adhesions, the fluid collects at the lower and posterior part

of the pleural cavity, allowing the lung in this situation to collapse by relieving it of the suction-action of the chest, which normally keeps it distended. The fluid is generally clear, straw-colored, with a faintly green tint, alkaline, and rich in protein material, which sometimes undergoes coagulation upon withdrawal of the fluid from the chest. In addition, the fluid contains large cells from the proliferating endothelium, leucocytes in various stages of transformation into pus-cells and, in some instances, red blood-cells. Urea, uric acid, and sugar may be found in it. The pus-cells are often sufficiently numerous to render the fluid somewhat cloudy, and may be so abundant as to convert it into a seropurulent exudate. The amount of fibrin is also very variable, in some cases forming only a thin layer on the pleura; in others, besides a thick, creamy layer, it forms whitish, curdy masses which collect where the movements of the pleural surfaces in respiration are least marked, especially in its folds and dependent portions. Where leucocytes become so many as to impart the characteristics of pus to the exudate, the condition is known as "empyema" (*q. v.*).

When an effusion fills the pleural sac the lung is compressed into a dark, airless and even bloodless mass at its root, and soon becomes permanently organized and solidified. In the left-sided effusions the heart may be so displaced that cardiac impulse appears near the right nipple and is caused by the impact, not of the apex, but probably of the right auricle and base of the right ventricle. In right-sided effusions the heart is pressed toward the left and the liver may be depressed. Upon organization of the adhesions these organs, with the great vessels, may be per-

manently displaced in various directions, and bronchiectatic cavities may be formed through traction upon the pulmonary tissues.

Serous pleurisy is only exceptionally accompanied by an increase in the number of white corpuscles, and then intermittently. The white count is of value in two ways in the diagnosis of serous pleurisy. If the physical signs are doubtful, and there is no leucocytosis, the condition is almost certainly not pneumonia or empyema, but serous pleurisy. If there is a serous pleurisy and a continuous leucocytosis, some complication is present. H. L. Morse (Boston Med. and Surg. Jour., Dec. 13, 1900).

PROGNOSIS.—In nearly all cases in which the fluid exudate remains serous, recovery takes place. The cases of simple pleurisy due to infection, the result of exposure, regularly recover. Death in disease of the pleura can occur: (1) from septic absorption; (2) from extension of disease to other structures, or (3) from interference with the functions of neighboring organs by the great bulk of the exudate.

The liability to sepsis depends on the nature of the infecting organism. Streptococcal infection is the most grave, as even after free drainage has been established general sepsis may supervene. Pneumococcal cases, common in children, usually run a favorable course, a few cases recovering after aspiration alone. Tuberculous cases are, of course, less favorable, the bacilli usually invading other structures, especially the thoracic lymph-nodes. The exudate is often sterile, however, and if the infection remains confined to the pleura these cases also do well.

After-history of 152 cases of pleurisy with effusion analyzed. Conclusions: Eighty per cent. of uncomplicated cases of pleurisy with effusion

are well at the end of five years, and more than half of them are well at the end of ten years or more. Only 15 per cent. develop demonstrable tuberculosis, and in many of these only after long periods of time after the pleurisy. The type of tuberculosis witnessed in the cases studied was a mild one. The family history is of great value in determining the prognosis. R. C. Cabot (Amer. Med., May 17, 1902).

The tendency of modern observers is to attribute all pleurisies of an acute type to tuberculosis. In the writer's experience, at least 84 per cent. of the cases are clinically not tuberculous. He warns the general practitioner against giving an unfavorable prognosis, unless there is definite tuberculosis or evidence of hereditary predisposition. Robin (Hospital, Sept. 23, 1911).

In serofibrinous pleuritis the danger is from the bulk of the fluid and the occurrence of double effusion and of pericarditis. Even large effusions may be absorbed rapidly, but this is more likely to be the case after aspiration of part of the fluid. In children and young adults, acute primary serofibrinous pleuritis is rarely fatal, absorption taking place within a few weeks. In advanced age serous effusions are much less frequent and the prognosis less favorable.

TREATMENT.—In many instances of mild pleurisy, unaccompanied by pronounced symptoms, spontaneous recovery doubtless occurs, possibly with slight adhesions remaining as a consequence. In all more pronounced cases, however, **rest in bed** is necessary, and should be continued until the acute symptoms abate. Even in the mildest appreciable cases this care is required, on account of the frequent tuber-

culous origin of the disease and the irritation of the inflamed pleural surfaces resulting from any increase of respiratory movement. Further slowing of the breathing may be secured by having the patient respire **air as fresh** as possible; the patient may be placed on a sleeping porch with advantage.

In mild cases of dry pleurisy, if pain is troublesome, **hot applications** or mild **counterirritants** may be sufficient to give relief; if pain is more marked or if cough is troublesome, small **blisters** over the seat of pain may be used. Even more rapid in action, however, are **dry** or **wet cups**, which, besides relieving discomfort, may shorten the duration of the disease.

Much relief in moderate as well as in more severe cases may be obtained by **immobilizing the side** by the application of overlapping **strips of adhesive plaster** extending from the spine to the sternum, the first strip being applied at the end of a forced expiration.

Ice-bags applied over the affected area and kept in place by a bandage often give marked relief, though **heat**, applied in the form of a **hot-water bag** or **compress**, is more agreeable to many. Capps uses **strips of linen** two inches wide and twelve inches long, **laid on ice**, applied parallel to the ribs, and frequently renewed.

In cases with severe pain 6 to 10 **leeches** may be applied instead if the patient is in ordinary robust health; but they should not be used in the young or the aged. The bleeding may be encouraged by hot fomentations or a large poultice. After it has ceased, a firm bandage to restrain the movements of the chest may give

relief, or even the adhesive plasters may be used.

In the more severe cases a hypodermic injection of **morphine**, later repeated if necessary, is the most effective means of obtaining relief. If even this measure fails, **venesection** may be resorted to.

Where cough is troublesome, it may be relieved with small doses of **morphine** or $\frac{1}{4}$ -grain (0.015 Gm.) doses of **codeine**. For high fever, **sponging** with **water** as cool as can be borne or with **alcohol and water** usually suffices. **Sodium salicylate** or **acetylsalicylic acid** may also prove useful in reducing temperature.

When there is moderate sero-fibrinous effusion, in addition to the above means, purging may be tried in the average fairly robust patients. For this purpose $\frac{1}{2}$ ounce (15 c.c.) or more of saturated solution of **magnesium sulphate** may be given in the morning before food is taken, the object being to deplete the blood and thus lead to rapid absorption of serum from the lymph-spaces of the pleural cavity. During the administration of the saline, the food should be dry and the quantity of fluid taken very small. Some advise the administration of **calomel** as well as the saline at the outset, to be followed by daily use of the saline or an **aperient water** until the temperature has returned to normal. **Sodium phosphate**, 2 drams (8 Gm.) in hot water daily, is also appropriate.

At times **salicylates** in full doses induce a marked polyuria and lead to disappearance of the fluid exudate. **Quinine** in average doses has been claimed to exert a favorable effect, and **potassium iodide** has also been recommended. Painting the affected

side with **tincture of iodine** or the application of a succession of small **blisters** is advised and sometimes does good. **Theobromine sodium salicylate** in 15-grain (1 Gm.) doses three times a day may be given as diuretic with a view to diminishing the pleural effusion. Where evidences of circulatory weakness appear, **digitalis** or **caffeine** may be administered.

Autoserotherapy, consisting in the withdrawal of a few to 10 c.c. of the exudate with a needle and syringe and its immediate reinjection under the skin, has given good results in many cases of pleurisy. Its actual value, however, is still undetermined.

Autoserotherapy was tried by the writer in 56 cases of serofibrinous pleurisy. Of these, 6 were failures. In 8 the results were unsatisfactory. In 42 the absorption of the effusion was complete and rapid. In 15 of the 42, only one injection was required; in the rest from 2 to 4 injections. The author comes to the conclusion that subcutaneous autoinoculation with the patient's exudate, whether in tuberculous or non-tuberculous cases, is quite harmless and causes neither local nor constitutional disturbances of any importance. There may follow a slight rise in temperature, but this amounts to no more than a fraction of a degree. N. T. Chigayieff (*Roussky Vrach*, No. 51, 1910).

The **Gilbert treatment** by **autoserotherapy** advised in all cases of pleural effusion where fluid not purulent. Upon exploratory puncture, do not withdraw needle entirely, but inject 2 to 5 c.c. (32 to 80 minims) of the fluid when its point is in subcutaneous tissue. In favorable cases, general amelioration was observed in two or three days; in about 80 per cent. of cases fluid will disappear in a week or ten days. In some patients treatment may have to be repeated several times

every two or three days before benefit appears. Fishberg (*Jour. Amer. Med. Assoc.*, March 29, 1913).

The author used **autoserotherapy** in 21 out of 155 cases; in 41 other cases various drugs were used in treatment, and in 93 merely hygienic-dietetic measures. It was impossible to detect any influence from the autoserotherapy on the course of the pleurisy in any of the cases in which there were signs indicating a tuberculous origin. The night-sweats and temperature were not modified. The tabulated details show that none of the measures applied seems to have shortened the course of the pleurisy. A. S. Artamonoff (*Jour. Amer. Med. Assoc.*, from *Pediatrics*, vi, No. 4, 1914).

Autoserotherapy is a reliable and safe method of treatment for all forms of serofibrinous pleurisy and should be employed in every case where pyemic infection is absent. A positive cure may be expected in over 80 per cent. of cases.

In secondary pleurisies autoserotherapy may not exert any beneficial effect on the primary cause of disease. It will cause rapid absorption of the pleuritic fluid, however, and in incipient tuberculous conditions has been known to arrest the progress of this disease. Charles A. Pfender (*Wash. Med. Annals*, Mar., 1914).

In 23 cases of tuberculous pleural effusion, the writer withdrew 5 c.c. (75 minims) of the effusion into an aspirating syringe. The needle was then withdrawn until the point was immediately beneath the skin, when it was introduced deeply into the subcutaneous tissue and the patient received the entire 5 c.c. subcutaneously. In 8 cases there was complete absorption within 2 weeks, while the treatment failed in 15. The absorption in the 8 was more probably due to the natural physical phenomena than to the stimulating effect of the treatment. The treatment may favor the tuberculous process. Lyter (*Am. Jour. Med. Sci.*, Nov., 1918).

Should absorption not begin at the end of ten days or two weeks, **aspiration of the fluid** is the most rational and effective therapeutic procedure. Rapid rise of the fluid to the third rib in front or the scapular spine behind with rapid respiration, orthopnea, and cyanosis peremptorily indicate intervention. But even where absorption is taking place, though very slowly, aspiration constitutes the treatment of choice. The same applies where dyspnea and cyanosis are the sole unfavorable phenomena noted, or where pronounced displacement of the heart or other nearby organs develops. There should be no delay in aspirating very large serous effusions with evidences of intrathoracic pressure with dyspnea, lest symptoms of heart-failure suddenly set in.

In 7 uncomplicated cases of pleurisy with effusion and 4 complicated cases the writer practised early **aspiration** of the effusion followed by the injection of from 150 to 600 c.c. (5 to 20 ounces) of **nitrogen** into the pleural cavity. Both pleural adhesions and a return of the pleural exudate are prevented by this method. The amount of nitrogen introduced into the pleural cavity must not be large enough to cause any compression of lung substance, and consequently it is better to control the amount injected by a fluoroscopic examination at the time of injection. Arnsperger (Therap. d. Gegenwart, lii, 495, 1911).

The writer never noted untoward effects when, after tapping the effusion in 40 cases he allowed **air** to enter the pleura through the trocar. The disease was often shortened; thick adhesions seldom formed, and the tendency to recurrence seemed checked. Hoogslag (Nederl. Tijds. v. Geneesk., May 18, 1918).

During the pyrexial period aspiration is said to be very liable to

be followed by a reaccumulation of the exudate. Reappearance of fever after it has disappeared from the acute stage is strongly suggestive of pus, which should be promptly evacuated (see section on EMPYEMA, in this article).

Where the diagnosis of pleural effusion and the location of the exudate are not reasonably certain, **exploratory puncture** with a 5- or 10-c.c. Luer syringe and large-sized hypodermic needle is frequently carried out as a preliminary to evacuative aspiration.

Frequently the withdrawal of a comparatively small quantity of even a very large effusion is followed by rapid absorption of the remainder. This is probably due to the removal of excessive pressure from the pleural lymph-vessels, allowing of their dilatation and of a free flow of lymph.

In small effusions the puncture with the aspirator needle must, of course, be made over the seat of effusion. When the effusion is large, so that the pleural cavity is nearly full, the best place for puncture is outside the angle of the scapula or in the middle line of the axilla, on a line with, or a little below, the nipple; *i.e.*, at about the seventh intercostal space, as the intercostal spaces are here wide and the chest wall thin. These places are safe unless the lung is adherent. In encapsulated and interlobar effusions, the signs elicited by auscultation and percussion must be taken as indications of the proper site of puncture. An overlying area of tenderness may also be of value in this connection.

The procedure of aspiration should be carried out with strict aseptic precautions. The skin surface to be

punctured having been cleansed with alcohol and tincture of iodine, a sharp, sterile trocar and blunt cannula—or a large hollow needle—are introduced at the site of election, preferably after making a small skin incision under ethyl chloride, infiltration, or ice and salt anesthesia. A very useful disinfectant and anodyne, to be used instead of iodine, is a saturated solution of phenol, applied over an area the size of a silver dollar and washed off twenty seconds later with alcohol (Capps). The trocar or needle should be introduced just above the upper border of a rib, in order to avoid wounding of the intercostal artery. The operation may be facilitated if the hand of the side to be tapped is placed over the opposite shoulder. After the incision it is well to introduce the needle with a sudden thrust, so that it may penetrate the layer of fibrin on the costal pleura and not carry it away from the chest wall. Suction may be obtained either with the Potain aspirator, provided with a pump; by setting fire to a little alcohol in a 2-liter (quart) bottle, to which the aspiration tube is then attached, or by means of a simple rubber siphonage tube leading to a receptacle containing water, which can be raised or lowered at will. The degree of suction applied should be sufficient only to maintain a gentle flow of fluid.

The latter measure should be discontinued as soon as the suction causes frequent cough, pain in the chest, or the appearance of blood in the fluid withdrawn. Occasionally a case is met with in which the fluid will not flow because the lung is so bound down that it cannot expand.

In such one must be content with the few ounces that can be withdrawn.

When conditions demand relief from the effusion at once, we can generally assume that the lung is not adherent to the pleura and can thus venture to use a simple **puncture** needle instead of a trocar. To regulate the pressure, and thus avoid doing harm by abrupt changes of pressure, the writer runs the needle into a fish bladder, when a suitable apparatus is not at hand. The fish bladder gives to the pressure and does not permit air to be sucked into the needle. The same purpose is accomplished by a tube on the end of the needle, the other end submerged in a vessel with salt solution. By raising and lowering the vessel the pressure in the needle can be regulated and the tube clamped with a clothes-pin. Grober (*Deut. med. Woch.*, July 16, 1914).

Paracentesis is usually well tolerated by the patient, though at times a tendency to syncope develops. Preliminary administration of an ounce (30 c.c.) of whisky is advised to guard against this tendency. Where syncope develops, the operation should be discontinued. Sudden death during a tapping has in rare instances occurred, though less frequently, according to Tyson, than in untapped cases.

The writer used injections of 1:1000 **epinephrin hydrochloride** solution into the pleural cavity in 20 cases, with constantly very favorable results. The amount injected was at first 0.3 c.c. (5 minims), and on the four or five succeeding days 0.2 c.c. (3.3 minims), in saline. Temperature began to descend on the third day, and the effusion underwent rapid absorption. Wedensky (*Pediatrics*, No. 6, 1913; *Semaine méd.*, Sept. 10, 1913).

The sitting posture is generally adopted during thoracentesis. Capps, however, prefers the recumbent posi-

tion, with the shoulders raised by pillows, or a lateral position, except in cases with marked dyspnea, asthma, or uncompensated cardiac disease.

Pleurisy is always to be treated as a serious disease, particularly if suspected to be of tuberculous origin. Efforts should be made to secure complete absorption of the exudation and full re-expansion of the lung, if necessary by repeated tapplings. Nutrition should be maintained at the highest possible level by **favorable sanitary conditions**, an abundant supply of good food, and such medication as the special features of the case call for.

Gradually increasing doses of **creosote** have appeared beneficial in some cases. **Out-of-door life** is as necessary as in other forms of tuberculosis. If retraction of the chest is progressive after disappearance of the fluid, **residence in high altitudes** may be desirable.

Any child that comes under the physician's care with a primary pleurisy should be considered as a possible—nay, more, a probable—victim of tuberculosis, and should be treated accordingly. There is no use in telling the parents that the child has "weak lungs" and that they must be careful that it does not "catch cold." Give explicit directions and leave nothing to chance. **Correct all abnormalities**, such as nasal obstruction, **prohibit school for a prolonged period**, unless the education can be carried on in the open air; and with this encourage outdoor games rather than the frequency of poorly ventilated places of amusement. **Fresh air** is to be prescribed day and night, and a personal inspection of the sleeping apartments should be made in order that a practical demonstration may be given. Mackay (Can. Med. Assoc. Jour., Aug., 1912).

The systematic practice of **deep inspiration followed by slow, obstructed expiration** has been recommended by McPhedran. For children this may be effected by blowing bubbles or by having 2 large bottles, 1 empty and the other filled with water, connected by tubing and a suitable tube with mouth-piece inserted into the full bottle, the child being encouraged to force the water over into the empty bottle by blowing into the full one. This may be done several times a day.

Chilling of the body, as well as **violent exercise and fatigue**, must be avoided for some time after subsidence of the acute process.

An important precaution to be taken in paracentesis consists in **not attempting to withdraw all the fluid at one sitting**. The drawing off of large quantities of fluid at one time may lead to albuminous expectoration, cough, syncope, acute edema of the lungs, and death. No rule can be laid down as to how much fluid should be removed at one time. It may be 300 c.c.; it may be more, but no more should ever be withdrawn than is necessary to remove all the symptoms. When dangerous symptoms reappear, or when the absorption does not take place in a few days, it is time to aspirate again.

During aspiration the patient should be as nearly as possible **recumbent**. He should also be carefully watched; if he coughs violently and spasmodically, if he has a sensation of constriction or feels faint or has great pain, the operation must be interrupted; after a little while, the symptoms having disappeared, another attempt may be made; if the symptoms again appear, the needle must be withdrawn and the patient put to bed. F. Forchheimer (Jour. Amer. Med. Assoc., Jan. 5, 1907).

Artificially induced pneumothorax by means of **oxygen, nitrogen or fil-**

tered air (Achard) has been used with success in some cases. Oxygen seems to give the best results.

Artificially induced **oxygen pneumothorax** in the treatment of pleurisy has been tried by the writer in cases of pleurisy with effusion, injecting the oxygen or air as the effusion was removed by tapping. Benefit was prompt and permanent, the pain and dyspnea subsiding at once. He found that filtering the gas through cotton did not keep out all germs, and he improved on this method by passing the gas through a Chamberland candle, with a contrivance to regulate the pressure and measure the amount used. He generally injected about the same amount as of the fluid withdrawn, allowing the gas to enter very slowly through an opening above the one made for the escape of the fluid, the patient sitting upright. By this means even large effusions can be drained away without causing any disturbances from the change in the pressure inside the chest. Molon (Gaz. degli Osped., March 22, 1910).

Referring to the Duvergey's experience in 36 cases of traumatic pleurisy following war wounds in which he resorted to **pulmonary decortication**, the writer found 49 cases of chronic empyema in which the same operation was performed by army surgeons, without a death. It is indicated in chronic empyemas with medium or large cavities due to war wounds. It promises success in chronic influenzal pleurisy. Delorme (Bull. de l'Acad. de Méd., Nov. 5, 1918).

CHRONIC PLEURITIS.

Under this term are included the forms of pleurisy in which the duration of the affection is greater than a few weeks. These may be classified into the *exudative*, including *chronic non-suppurative pleuritis* and *chronic suppurative pleuritis* (empyema), and the *plastic* or *dry*, occurring in the *primary* and *secondary* varieties.

CHRONIC NON-SUPPURATIVE PLEURITIS.—This may follow acute serofibrinous pleurisy. Paracentesis may be performed from time to time, but the fluid reaccumulates. The exudate continues to be serous, with, in some cases, a large deposit of gelatinous material on the pleural surfaces. After months or even years some retraction of the chest may take place, showing that the fluid has been partly absorbed. There may have been no symptoms except some dyspnea on exertion, lighter occupations being pursued with comfort.

In other cases the affection is latent from the beginning (*latent pleurisy*). The onset is not marked by any symptoms that attract attention. With the accumulation of fluid, dyspnea appears on severe exertion and becomes more easily provoked as the fluid increases. Inquiry into the history usually reveals more symptoms than the patient was aware of. Clubbing of the fingers and toes may be marked.

Probably the great majority of these cases are of tuberculous origin, the condition being analogous to cases of peritonitis with similar pathological changes and a similar history.

TREATMENT.—Aspiration should be resorted to in these cases and repeated as often as the fluid reaccumulates, as much of the fluid being removed as will flow without distress to the patient. **Autoserotherapy** may be tried. If reaccumulation occurs after the third evacuation **continuous siphon drainage**, using a cannula of such size that a small drainage-tube can be slipped through it, may be employed for a time. Or, when it seems useless to repeat aspiration,

active **counterirritation** to the chest may be continued and short courses of **alterative drugs** given. Every means possible to improve the general health should be adopted, as an **out-of-door life, respiratory exercises, nutritious diet, and a change of residence.** A sojourn in **high altitudes** does good in some cases, being followed by re-expansion of the lung.

If the exudation becomes purulent, it is drained (see following section).

CHRONIC SUPPURATIVE PLEURITIS (Empyema; Pyothorax).—This is manifested as an accumulation of pus in the pleural cavity. Among the subsidiary varieties of empyema are the following: Pulsating, multilocular, double (bilateral), interlobar, and tuberculous. The first three of these terms are self-explanatory. Interlobar (often erroneously termed interlobular) empyemas follow inflammation of the pleural surfaces separating adjacent pulmonary lobes, and, though not primarily abscesses of the lung, merge into the latter condition when not circumscribed by adhesions or evacuated early. Tuberculous empyema occurs in scrofulous subjects and is often localized, with caseous masses.

SYMPTOMS.—In most cases of empyema there is a history of exposure to dampness or overheating. A chill comes on, then fever and severe pain in the side, frequently followed by a more or less complete subsidence of the symptoms. In a few days dyspnea and unusual restlessness call the attention of the patient again to his chest. In some cases the disease is identical in its onset and course with the ordinary acute serofibrinous pleuritis, to which it becomes superadded as a complica-

tion. In a month or two the patient is likely to have become emaciated, pale, weak, and morose, with a short, loose cough suggestive of tuberculosis—a suspicion apparently confirmed when night-sweats are noticed. The aspect is that of extreme exhaustion. Pain in the affected side may be one of the first symptoms; but the most marked of these are dyspnea and general prostration due to the absorption of pus. The skin may be clammy and bathed in a cold perspiration. The respiration is about 40 to the minute; the temperature from 103° to 105° F. (39.4° to 40.5° C.). The blood shows a polymorphonuclear leucocytosis.

PHYSICAL SIGNS.—These are, on the whole, the same as those in acute non-suppurative pleurisy, consisting of dullness or flatness on percussion of the affected side, together with disappearance of vocal fremitus. The respiratory sounds are nullified, though the bronchial murmur of a preceding pneumonia may be perceptible just above the pus-filled area. The following differences between the signs of a serous and a purulent pleural effusion are of significance: (1) the intercostal spaces are more likely to protrude in the latter condition, owing to infiltration and consequent paresis of the intercostal muscles; (2) whispered pectoriloquy is less transmitted through a purulent than a serous exudation (Baccelli's sign); (3) a localized area of edema over the effusion almost certainly points to its purulent nature, and (4) in children there may be an extraordinary enlargement of the affected side of the chest (Kelly).

Characteristic of cases of empyema supervening upon lobar pneumonia,

according to Hale White, is an apyrexial interval of one to five, usually two or three, days between the fall by crisis in pneumonia and the rise of incipient empyema. The temperature now rises from 2° to 4° or 5° F. above normal in the evening, and 1° or 2° in the morning, this condition continuing until the pus is evacuated. To be sure, in some cases there is no, or only an incomplete, apyrexial interval, the fever of pneumonia merging into that of empyema.

In cases of empyema where the accumulation of pus is only slight, but little more than dyspnea and a rise of temperature are seen.

The natural termination in a case of empyema not recognized and treated (unless death takes place from sepsis and exhaustion) is rupture at the points of least resistance, viz., internally, above into the bronchi or trachea, or, externally, at the free spots of Marshall or of Traube. The point on the right flank which is comparatively free from muscular covering is called the free spot of Marshall, while that on the left side is the region of Traube. Cox has reported a case in which spontaneous evacuation took place in front between the sixth and seventh ribs, with recovery. The pus may discharge through the intercostal spaces, but fail to reach the surface at that point on account of the muscles; it then burrows beneath them. In one case it escaped at the umbilicus.

DIAGNOSIS.—The diagnosis may be made from the extreme dullness and lack of respiratory sounds, combined with persistent temperature elevation. Recurring chills, fever, and sweats, with local edema of the chest wall and polymorphonuclear

leucocytosis, conclusively indicate purulency of an effusion. If doubt arises, an exploratory puncture, with cytological and bacteriological examination of the fluid obtained, is advisable.

At times cases of empyema may be confounded with ordinary *intramural abscesses*, as when they occur near the axilla, and are incised. *Pulmonary abscess* and *subdiaphragmatic abscess* are other possibly confusing conditions to be borne in mind.

The so-called "pulsating empyema," transmitting the cardiac systole to the chest wall between the second and fourth ribs anteriorly, the third and fifth ribs in the axilla, or over an extensive area, is not likely to be confounded with an aneurism.

In children the course of empyema is often brief and critical, some cases succumbing within forty-eight hours. The signs in these cases are the same as in *pneumonia*, and exploratory puncture is essential if a correct diagnosis is to be made.

ETIOLOGY.—In some instances the etiology of empyema is that of acute pleurisy, in which it originates. The clear exudate of the former, perhaps because of secondary infection from without (possibly through thoracentesis), becomes progressively more cloudy and richer in cells until the characteristics of pus have been assumed. In other cases the condition is purulent at the outset or becomes so very soon. Among the etiological conditions in these cases are: infected chest wounds, infective disease of the thoracic bony cage, mediastinum, or abdominal viscera, septicopyemia, rupture of tuberculous lung cavities or bone abscesses (ribs or vertebræ) into the pleura, and general infections

such as scarlet fever, typhoid fever, measles, etc.

In adults the micro-organisms usually responsible are the streptococci or staphylococci, less frequently the pneumococcus, the colon bacillus, the tubercle bacillus, and the typhoid bacillus. In children, in whom very many instances of empyema follow pneumonia, the commonest organism is the pneumococcus. In infancy, practically all pleural effusions are purulent from the outset or soon become so. Hartwell found in children that pneumonia caused 50 per cent. of the cases of empyema; the pneumococcus was found in one-half the instances where the pus was examined bacteriologically, and the streptococcus in about one-fourth. Blaker found the pneumococcus in 65 out of 69 cases.

PATHOLOGY.—In the incipient cases, in which the exudate is as yet only seropurulent rather than purulent, the pathological changes in the pleura are those of serofibrinous pleurisy, though more marked, consisting of pronounced thickening of the membrane, appearance of a dense fibrinopurulent covering layer, and a pronounced infiltration with polymorphonuclear leucocytes. When true purulency has supervened the exudate is thicker, especially in pneumococcic cases, and may then separate into two layers, the lower of thick pus and the upper of thin, greenish serum.

In some neglected cases, or cases following abscess or gangrene of the lung, stab wounds, or cancer of the esophagus, the fluid may become foul-smelling (*putrid or fetid pleurisy*).

PROGNOSIS.—While in untreated or poorly treated empyema the prognosis is unfavorable, cases seen early

terminate favorably under proper treatment. Even in spontaneous rupture externally or into the lung recovery may eventually occur, though the fistula is likely to persist for some time. The nature of the causative bacterium is of some significance in the prognosis, infection with the pneumococcus being, on the whole, less serious and persistent than with the streptococcus. Tuberculous pleuritis is a chronic process usually terminating fatally, lasting for years until tuberculosis or an intercurrent affection carries off the patient, or until he gradually succumbs to prolonged hectic amyloid disease and asthenia.

The readiness with which the compressed or retracted lung returns to fill the cavity when drainage has been established is also a measure of the prognostic tendency of the case as to ease of repair and prompt return to normal health.

Danger to life in empyema is attendant chiefly on complications such as pericarditis, peritonitis, and septicemia. In all cases the most serious residual consequence of the affection is deformity, and in children lateral spinal curvature is likely to occur where there has been long-continued discharge from the pus-cavity.

While in most cases of empyema the cavity closes under treatment, even when healing has been delayed many months, recurrence may occur at any time from faulty drainage. Pyemia and septicemia result from putrid empyema, and generally miliary tuberculosis may follow a localized tuberculous pleurisy which becomes purulent. Rupture into the bronchi, trachea, or lungs, with immediate death from suffocation, or

into the stomach after perforation of the diaphragm, are among the possibilities. According to Cotter the mortality from empyema is about 1 in 7; it is much greater in small children than in those above five years of age.

TREATMENT.—Empyema being not infrequently a sequel to non-suppurative pleuritis, a preliminary discussion of its prophylaxis is in order. **Blistering and purgation with salines or mercurials**, or both, are the measures chiefly relied upon in the attempt to arrest the pleural inflammation early enough to avoid suppuration. Gaston strongly urges, especially in children, an early recourse to the following preparation:—

℞ *Hydrargyri chloridi mitis*,
Pulveris camphoræ
 āā gr. j (0.06 Gm.).
Pulveris ipecacuanhæ et opii,
Quininæ sulphatis
 āā gr. x (0.6 Gm.).
 M. Divide into powders no. x.
 Sig.: One powder every two hours.

In adults, larger doses are to be used:—

℞ *Hydrargyri chloridi mitis*,
Pulveris camphoræ
 āā gr. vj (0.4 Gm.).
Pulveris ipecacuanhæ et opii,
Quininæ sulphatis
 āā gr. xxx (2 Gm.).
 M. Divide into capsules no. xij.
 Sig.: One every two hours in the daytime, and 2 at intervals while awake at night.

This should be followed with two tablespoonfuls of **castor oil** and one teaspoonful of **turpentine**. The bowels are thus emptied, and the turpentine has a beneficial effect upon the bronchial tubes.

Gaston has seen many incipient cases aborted in this way, and the most alarming symptoms of high temperature and rapid respiration controlled.

The writer treated 14 cases of pleural empyema by **tapping and injection of formaldehyde in glycerin**. The results were not encouraging, and this method should by no means take rank with **thoracotomy**. G. Nyström (*Hygiea*, Sept., 1913).

The writer reports 6 cases of empyema in patients of various ages in which benefit was obtained by the **aspiration of the pus**, and the immediate **injection** of from 2 to 6 c.c. ($\frac{1}{2}$ to $1\frac{1}{2}$ drams) of a 2 per cent. solution of **formalin** in glycerin. Alexander McPhedran (*Can. Med. Assoc. Jour.*, Sept., 1914).

In penetrating gunshot or stab wounds of the chest, complete **interruption of communication between the pleural cavity and the outer air** should at once be secured, and careful **antisepsis** instituted whenever the indication exists. Collections of **blood-serum or air in the pleural cavity** should be early **evacuated by aspiration**.

As soon as the existence of empyema has been discovered, **surgical principles** should be followed in the treatment, pus in the pleural cavity requiring evacuation as in the case of any other abscess. Preliminary aspiration is not necessary, unless the symptoms demand immediate partial relief from pressure on the lung, pending more complete removal a day or two later. In a few cases of empyema in children, recovery takes place after one or two aspirations; but if there is reaccumulation of pus, provision for free and continuous **drainage** should at once be made. Even in the most desperate cases whatever

procedure seems best to procure drainage is definitely indicated, though, where the size of the exudate is so great as to cause cardiac displacement, **gradual evacuation** by aspiration is recommended by some. The latter form of drainage may be effected by the use of a trocar and cannula, followed by insertion through the cannula of a small catheter, held in place by a collodion dressing and attached to a long tube running down to a vessel containing an antiseptic solution. **Continuous drainage** is thus provided by **siphonage**—a procedure asserted valuable where subsection of the patient to the knife seems unwise.

The writer employed **continuous drainage** in empyema in 43 patients in the last ten years. About 55 per cent. were cured; in none of these cases had the empyema been installed for more than six weeks; 3 boys and 2 girls were under 10; 4 boys and 1 girl were under 20. In only 2 cases was tuberculosis certain; it was suspected in 2 others among the 24 cases of recovery. His experience confirms the advantages of permanent drainage according to Bülow's technique; with this a flat flask is suspended by a strap from the opposite shoulder. The empyema drains into the flask through a rubber tube and drain inserted at the lowest point of the empyema, held in place with straps of adhesive plaster. A clamp on the tube is opened every two or three hours to allow not more than 200 c.c. (6 $\frac{2}{3}$ ounces) of pus to escape; it is important not to drain too much at one time. This technique is excellent for acute and not too old empyema. Frank (Jour. Amer. Med. Assoc., from Med. Klinik, March 12, 1911).

The writer recommends the following convenient method of **drainage** of empyema in young children: After locating pus with aspirating needle, insert narrow-bladed knife under it

and enlarge wound just above a rib enough to admit snugly a short drainage-tube of rather stiff rubber, which is held in place by a cuff of slightly larger tubing, a piece of tape slipped over it, and adhesive plaster fastening tape to skin. Connect rubber tube with glass tube passing through cork of a pint bottle and dipping in warm, sterile salt solution contained in it. Raise bottle till solution runs slowly into pleural cavity, then lower, thus irrigating pleura. Change salt solution two or three times daily, or as often as necessary to keep it fairly clean. Kenyon (Med. Record, Oct. 21, 1911).

In **drainage** of the pleural cavity after **pleurotomy**. The incision must be made as far down on the chest as possible—generally in the ninth intercostal space—and should encroach slightly on the dorsal region and not be exclusively on the lateral aspect. R. de Bovis (Semaine méd., July 29, 1914).

In children empyemas not uncommonly heal after thoracentesis alone. Of 465 cases of acute pneumonia there were 32 cases of empyema, or 6.8 per cent. The best results were obtained by resecting that rib which in the sitting or half-sitting position of the patient corresponds to the lowest point of the pleural cavity. A piece about 10 or 12 cm. was resected in all his 27 cured cases. G. Nilson (Nord. med. Ark., Kirurgi, Part 1, No. 5, 1916).

Under routine methods of treatment, the mortality remains nearly constant. Greater individualization reduces it markedly. Where the patient is extremely ill, a **simple thoracotomy**, between two ribs, with insertion of a **drainage tube** is indicated as initial operation. Later, when conditions are favorable, the **chest** is **opened** freely. The incision of the thickened pleura to liberate the lung often discloses unsuspected pus pockets, which are also evacuated, and with the X-ray other pockets are located, and all are opened. The wound is closed, room for drainage

alone being left. Under such treatment many cases are cured without secondary sinking in of the chest wall. Lilienthal and Ware (N. Y. State Jour. of Med., July, 1916).

In all ordinary cases of empyema, however, drainage by incision of the chest wall (**thoracotomy**), with or without **resection** of a **portion** of a **rib**, is indicated. The operation may be performed either immediately upon discovery of the purulent nature of the exudate by **paracentesis**, an incision being made precisely where the exploring needle has struck pus, and before it is withdrawn, or a short time later, where the necessary preparations for incision had not been made at the time of thoracentesis. Where the pus-cavity is not a circumscribed one, the opening is generally made in the sixth or the fifth interspace, beginning at the anterior axillary line and extending back two inches or more. According to some, satisfactory results may be had by incising even in the eighth or ninth interspaces in the midaxillary line. Masses of lymph that might interfere with subsequent drainage may be broken down with the fingers. The further conduct of thoracotomy has been described in the article on the CHEST, SURGICAL DISEASES OF, vol. iii, to which the reader is referred (section entitled "Operations on the Chest"). Two rubber drainage-tubes are inserted through the opening made, and the pus is permitted to escape continuously into a thick compress of gauze held loosely over the opening with a binder. Although some air enters the pleural cavity during inspiration, this is not an undesirable event, a slight positive pressure being produced at each expira-

tion which assists in pressing out the pus through the drainage-tubes. As the discharge becomes less in amount and the pleural cavity becomes smaller through healing of the visceral pleura with the parietal, the drainage-tubes require shortening, to prevent contact with the lung and the diaphragm, and may soon be replaced by tubes of smaller diameter, before complete healing takes place. It should be borne in mind that the ordinary drainage-tubes, if allowed to irritate the lung, may themselves be responsible for a continuance of discharge.

Rib resection during thoracotomy is advised as a routine procedure by some. It is especially indicated, however, where the intercostal spaces are so narrow that drainage-tubes can only be maintained with difficulty, as in children and some adults. Removal of a short piece of a single rib is all that is required. Dowd in children excises about $1\frac{1}{2}$ inches of the seventh or eighth rib in the posterior axillary line. Schultz advises careful investigation of the lower and posterior borders of the healthy lung, followed by resection, on the affected side of the rib situated 2 or 3 cm. above this level, near the spinal column. Others select the sixth or fifth rib in the midaxilla (see article on the CHEST, SURGICAL DISEASES OF, vol. iii).

Where the exudate is being thoroughly drained, the amount of discharge decreases in a few days. The temperature should fall after the discharge of pus. Should it not do so, either the drainage is ineffectual or incomplete, or some other pathological condition is present. Recurrence of chills, fever, and sweats and

increasing leucocytosis, after drainage has proven satisfactory for a period, similarly point to obstruction to the outflow of pus requiring correction.

It is rarely, if ever, desirable to irrigate the pleural cavity with any kind of fluid. Complete drainage suffices even in fetid cases, and statistical study has demonstrated that healing is more rapid where irrigation is not practised. The strands of repair tissue are broken; thorough antisepsis is not possible, since many of the bacteria are imbedded beyond the reach of the irrigating fluid, and there is some danger, albeit very slight, of the induction of syncope or complicating conditions such as hemiplegia, convulsions, or even sudden death. The nature of the fluid employed does not appear to have anything to do with the frequency of untoward results, bad results having followed the use of pure water or saline solution as well as more irritating antiseptic fluids. Through an ulcer on the pleural surface of the lung fluid may escape into the bronchi and cause shock or suffocation through obstruction of the bronchioles radiating therefrom. **Irrigation with potassium permanganate solutions** is advised by some in cases of putrid empyema. Solutions of other antiseptics, such as **iodine, boric acid, and salicylic acid**, are also sometimes used.

When evacuation of the pus in the pleural cavity has been secured, a persistent attempt must be made to induce expansion of the involved lung by means of **calisthenic and respiratory exercises**,—blowing water from one bottle to another through a narrow tube, etc. Treatment by means of **valve or suction apparatus** has at times proven useful.

Firm adhesions or fibrosis of the lung in long-standing cases may render the organ incapable of expanding, in spite of the institution of adequate drainage of the pus-cavity. In these cases suppuration will persist as long as the pleural space remains unobliterated. **Surgical treatment** of the overlying chest wall which will permit it to come in contact with the contracted lung is therefore indicated. Where the intervening space is of moderate size, **Estländer's operation**, which consists in the removal of a considerable section of each of the ribs overlying the cavity, is indicated. The soft tissues of the chest wall are thus permitted to recede into contact with the lung. In inveterate and extensive cases in which even Estländer's operation has not yielded a cure owing to excessive thickening and stiffness of the pleura, **Schede's operation**, consisting in removal of the entire chest wall from the second to the ninth or tenth rib, including the intercostal muscles, is sometimes performed. After this operation only the parietal pleura, superficial muscles, and skin remain to cover the lung.

Of the 118 patients with empyema operated at Ise, Japan, since 1900, 93 were children. Healing was not complete in adults under six months, but the children healed up much faster. Twelve adults died and only 8 were permanently cured, but 72 per cent. of the children were cured; 14 per cent. died. Hirano (*Deut. Zeit. f. Chir.*, Sept., 1913).

Analysis of 178 cases of pleural empyema in the last ten years. The mortality was only 11.5 per cent. in the 61 idiopathic cases while it was 21.1 in 71 following pneumonia; 33.3 per cent. in the 6 measles cases, and 38.5 per cent. in the 39 scarlet-fever cases. The mortality was the highest

with mixed staphylococcus and streptococcus infection. Werner (Deut. Zeit. f. Chir., Sept., 1913).

Delorme's or Fowler's operation, also termed **decortication of the lung**, is of value where the visceral (pulmonary) pleura has become so thickened as to bind down the lung and prevent its expansion. It is sometimes combined with Estländer's or Schede's operation, but may also be performed independently of these through a temporary osteoplastic flap in the chest wall, exposing the lung, from which the fibrous covering is then removed as completely as possible by stripping and the use of scissors. The thickened pleura is also removed from the thoracic parietes and the diaphragm. For details of the technique of each of these operations, the reader is referred to the articles on the CHEST, SURGICAL DISEASES OF, vol. iii.

The writer favors the **Delorme-Fowler method**. The real credit of devising the operation, he thinks, should be given to Delorme, of Paris, though both published it about the same time. F. B. Lund (Jour. Amer. Med. Assoc., Aug. 26, 1911).

Five cases are cited by the writer to illustrate the possibilities of **decortication of the lung** for old empyema. The patients have their normal capacity restored. The procedure is not as severe as a complete Schede operation, although it appears much more formidable. Hemorrhage from the denuded lung is not ordinarily severe. In several instances it was extremely slight, and, while the lung was injured enough to allow air-bubbles to escape in almost every case, no harm has arisen from such injury and apparently no infection in the lung has occurred. Beckman (Northwest Med., March, 1914).

The use of **Dakin's solution** is the best method of choice in ordinary chronic empyema cavity of any size. A **pulmonary decortication** through

a rib spreading exposure after preliminary irrigation is the most conservative treatment for cavities that are not obliterated by drainage or solution treatment alone. If the lung does not expand, or if a considerable cavity persists following it, a **plastic operation** is indicated. In the absence of bronchial fistulas and of bleeding, secondarily infected tuberculous empyema may be much benefited by the antiseptic solution. Adequate **drainage** is the first indication in cases of empyema cavities which are draining through large bronchial fistulas. Operative closure of bronchial fistulas that persist is necessary to complete healing. Operative mortality in chronic empyema has been due largely to shock and infection. Reduction of the extent of operation and preliminary sterilization will materially lower this mortality. Hedblom (Annals of Surg., Sept., 1920).

In children, in whom pneumothorax causes greater difficulty of respiration than in adults, previous removal of a portion of the purulent exudate with a sharp trocar is often advisable, in order to minimize the ill-effects of the succeeding operation to establish continuous drainage. **Rib resection** may be freely done, as regeneration of any removed portion will readily occur.

In 22 cases of empyema in infants, all were under 1½ years old, 19 being under 1 year of age. All of these cases came to operation and show very clearly how great is the mortality in empyema in infancy. There were 15 deaths among the 22 cases. Bacteriologically, 20 cases were examined; 14 showed the pneumococcus in pure culture; 3 the streptococcus, and 1 a mixed infection of streptococcus and staphylococcus; 2 of the cases were sterile, 1 of which proved on autopsy to be tuberculous. As the best operative procedure, the writer advises introducing a **trocar and needle** and removing as much **pus** as possible. Resection causes the greatest mortality, because infants

stand the shock of the operation very badly. F. Zybelle (Monats. f. Kinderheilk., Aug., 1912).

Where exploration with the needle leads to the discovery of an encapsulated, circumscribed empyema, **incision** in that locality and the institution of **drainage** are, of course, indicated. The interlobar form of pleurisy, according to Segond and others, is best treated by **excision of the fifth and sixth ribs**. In bilateral empyema, the orthodox treatment is **aspiration** of one pleural cavity at a time, followed by **chest incision** on one side and the use of a **trocar** on the other, according to the relative degree of lung expansion on the two sides induced by the aspiration.

In empyema occurring in cases of pulmonary tuberculosis, many prefer **aspiration** to free incision and the institution of continuous drainage, considering the condition analogous to a cold abscess and laying stress on the dangers attending superadded mixed infection of the pleura. Others advise **rib excision** and **free drainage** on the ground that they have saved life in numerous instances. Perhaps the most reasonable view is that of Baumbler, who recommends **thoracotomy** with **rib resection** where exploratory puncture shows suppurative bacteria in the pus, and **aspiration** where such organisms are not present. The condition has been cured by **thoracentesis** followed by injections of **mercury bichloride** and **boric acid** solution through the same needle. Park resorted to **scraping** with the sharp spoon, and in some instances **cauterized** the diseased surface with a solution of **zinc chloride**.

The creation of an **artificial pneumothorax** by the injection of **nitrogen**,

filtered air or **oxygen** may be resorted to, and will prove most useful in well marked or advanced strictly unilateral cases, according to Floyd (1913).

After 2 years' experience with **continuous aspiration**, the writer used it in 4 cases of traumatic empyema due to shell and bullet wounds. A rubber tube $1\frac{1}{2}$ meters long was passed into the most dependent portion of the chest and the margins of the wound drawn together round it or the opening racked with small compresses. The free end of the tube, passed through the dressing, was adapted to the lateral outlet tube of Tuffier's spiral horn shaped device. One and one-half meters above the level of the bed a 2-liter tank filled with water was placed, and from it the water dripped rapidly through a rubber tube into the horn, producing constantly a vacuum in the lateral outlet of the latter and the pleural tube. The rate of dripping was regulated with a Murphy device and pinch cock. The dressings are never soiled, and there is no odor. The previously cachectic patients are very promptly restored to a healthy appearance. Dauriac (Bull. de l'Acad. de Méd., Aug. 7, 1917).

Where actinomycosis becomes complicated with empyema, the pleural infection is usually secondary to disease of the lung. Spontaneous evacuation through the chest wall not infrequently occurs. If not, measures to remove the pus should be taken. Massive doses of **potassium iodide** should also be administered.

CHRONIC DRY (PLASTIC) PLEURITIS.—This condition may either be preceded by pleural effusion or develop gradually as a dry pleurisy. In the first, or *secondary type*, after the absorption of the fluid there persists on the pleural surfaces a more or less marked deposit of

"lymph," some of which becomes organized into firm connective tissue. The respiratory movements are thus in some degree hindered, and dullness on percussion is noted, together with weakening and absence of the respiratory sounds and perhaps some retraction of the chest wall. The cicatricial tissue is most in evidence in the purulent cases, especially in those in which the discharge has persisted a long time. The lung is rendered airless and fleshy in these cases. In less-marked instances bronchiectasis may be produced.

In the second or *primary type* of dry pleurisy there is no history of a preceding pleural effusion. The resulting adhesions are usually limited to circumscribed areas of pleura, and are not infrequently met with at the autopsy table. Even though they be general, the respiratory functions may be unimpaired, and the exudate be so slight that upon examination no disturbance except Litten's diaphragm phenomenon is noted. Retraction of the intercostal spaces, together with loss of resonance on percussion and weakness or absence of the respiratory sounds, may be observed in the more serious cases, with pronounced pleural thickening. Fibrosis of the lung frequently coexists.

The form of chronic dry pleuritis known as pleurogenic pneumonia is associated with formation of a thick morbid-tissue deposit of tuberculous nature, which penetrates from the pleura in between the lobules of the lung-tissue, dividing it into distinct areas separated ultimately by connective tissue. Extreme thickening of the pleura itself may, moreover, occur in pulmonary tuberculosis.

Chronic adhesive pleuritis may also be part of a general chronic inflammation of serous membranes—multiple serositis or polyorrhomenitis—involving the peritoneum and pericardium as well as the pleura.

The symptoms of chronic dry pleuritis vary considerably. Among the most frequently met with are: dragging pain or aching in the side, becoming worse during inclement weather; dyspnea, particularly on exertion; impairment of the respiratory movements and sounds on the involved side; lessening of resonance and vocal fremitus; obscure friction sounds; and, in advanced cases, thoracic deformity and visceral displacements.

In addition, symptoms of coexisting chronic bronchitis or pulmonary tuberculosis may be present.

TREATMENT.—The treatment of chronic dry pleuritis should include the prescription of **pulmonary gymnastics** and regulated **outdoor exercise**, to favor expansion of the lung; **massage of the walls of the thorax**, and attention to the patient's general health. Such drugs as **iron, strychnine, quinine, nux vomica, hydrochloric acid, mercury, phosphorus, iodides**, and **codliver oil** should be administered when indications therefor are present. The **diet** should be **generous** and proper **hygienic** conditions provided for: Locally, **counterirritation** with **iodine** or appropriate ointments may be availed of to relieve pain.

PNEUMOTHORAX.

Under this term are grouped conditions in which air or other gas is present in the pleural cavity. Pure pneumothorax is exceedingly uncommon, fluid being nearly always

also present in the pleura, in which case the terms *hydropneumothorax*, *pyopneumothorax*, and *hemopneumothorax* are more strictly applicable.

SYMPTOMS.—In rare instances the onset of pneumothorax is slow, and symptoms are slight or absent, the condition being ascertained only by accident or at autopsy. In nearly all cases, however, the onset is rapid and severe, with sharp pain in the chest, pronounced dyspnea, cyanosis, and often symptoms of collapse, such as a rapid, feeble pulse and sweating. A sensation as of something giving way or of fluid trickling down within the thorax may be experienced. Death may follow rapidly if the affected lung has been playing the chief rôle in respiration in the individual case, if the escape of air into the pleura is rapid, or if the opening in the lung is of such a “valvular” type as will permit entrance of air into the pleura during inspiration—the suction effect of the chest assisting—but prevent its escape through the bronchus during expiration. On the other hand, the symptoms may be but slightly marked in advanced pulmonary tuberculosis, the respiratory needs being small and the pain, which is the most constant manifestation in such cases, being readily referable to a simple localized pleurisy, which is present very often in these patients. Careful investigation is thus desirable, to find out the cause of such attacks of pain in pulmonary tuberculosis. In neither advanced phthisis itself nor superadded pneumothorax is a persistently rapid respiration necessarily associated with dyspnea. As the air and liquid effusion increase in the pleural cavity the patient may breathe 50 or more times

to the minute without complaining of breathlessness.

PHYSICAL SIGNS.—In well-developed cases the physical signs are very characteristic. Upon raising the patient, who is apt to be found lying on the affected side to allow free play to the normal lung, to the sitting posture, the involved side is found enlarged and nearly motionless. The intercostal spaces are obliterated or bulging, and the cardiac impulse may be seen to be considerably displaced. The respiratory movements on the opposite side of the chest are exaggerated.

Palpation may reveal the heart displaced and the liver pushed downward, the latter especially in right-sided pneumothorax. Tactile fremitus over the affected lung is greatly diminished or absent, except perhaps over the site of adhesions of the lung to the chest wall. The degree of change in the percussion note depends upon the state of intrapleural tension, the tension of the intercostal muscles, and whether the pneumothorax is “open” or “closed.” In the majority of cases, intrapleural tension not being augmented, it is clearly hyperresonant or tympanitic. This note frequently extends considerably beyond the usual limits of the affected lung, being transmitted across the sternum, because of displacement of the heart and mediastinum. Where there is increased intrapleural tension or contraction of the intercostal muscles, on the other hand, the note may be dull and the feeling of resistance on percussion increased. Frequently, moreover, there is dullness at the base of the chest, due to fluid accumulation in the lower portion of the pleural cavity:

this dullness shifts with the changes in the patient's posture. At times the tympany obscures the dullness of fluid actually present; or, the fluid may fail to yield dullness in the erect position because of having created for itself a concavity in the upper surface—normally convex—of the diaphragm, no fluid being thus in contact with the outer chest wall. A cracked-pot sound may at times be obtained.

Upon auscultation of a well-marked pneumothorax the breath sounds are usually found much reduced or absent, especially upon listening at the lower part of the thorax. What breath sounds exist may be metallic, bronchial, or amphoric in quality. The higher the intrapleural pressure the less distinct, as a rule, the breath sounds; if the pressure is low and the perforation open, loud amphoric breathing may be heard, due to transmission of bronchial sounds into the resounding pleural cavity. The vocal fremitus, as well as any râles present, also often possess a metallic quality. The phenomenon known as metallic tinkle, or falling-drop sound, can frequently be elicited upon deep breathing, coughing, speaking, swallowing, or movement of the body. The coin sign, elicited by the tapping of a coin placed flat on the front of the chest with another coin, while the observer listens on the back of the chest, is another characteristic sign of pneumothorax; when it is positive, a ringing, metallic sound is conveyed to the listener. Entrance or exit of air through the opening in the lung into the pleura sometimes gives rise to a peculiar whistling sound, which is especially characteristic when the opening is submerged in the intra-

pleural fluid. The Hippocratic succussion splash may be heard when both air and fluid are present in the pleura and is elicited by shaking the patient or requesting him to make sudden movements such as rapid sitting up or lying down; in some instances it is heard not only upon auscultation, but also at a distance. It may transmit a shock to a hand placed over the chest. The heart sounds in pneumothorax may be muffled or possess a metallic quality.

DIAGNOSIS.—Where the typical mode of onset, cause, and symptoms and signs of pneumothorax are present, even only in part, the diagnosis of the condition is readily made.

Pleural effusion has not infrequently been diagnosticated in cases with high intrapleural tension, the percussion not being relatively dull. Absence of the resistance to the percussing finger typical in pleural effusion and of the other signs of the latter condition should, however, avoid confusion in most instances.

Cavity of the lung in pulmonary tuberculosis, when extensive, may simulate pneumothorax in yielding tympany, amphoric breath sounds, metallic tinkling, and at times succussion splash. Absence of recession of the intercostal spaces and of the chest wall as a whole, as well as a negative coin test and a displacement of the heart, if anything, to the side of the lesion, are strong indications of cavity and of the absence of pneumothorax. Occasionally it is impossible to distinguish a small pneumothorax due to rupture of an emphysema into a bronchus or to the extension of a pulmonary cavity to the surface, from a cavity lying near the periphery of the lung.

Emphysema is bilateral, while pneumothorax is unilateral. In cases of fibrosis of one lung the compensatory emphysema of the opposite lung may simulate pneumothorax in physical signs, including displacement of the heart. Pneumothorax occurring where the opposite lung is so much crippled, however, would cause the direst distress,—a differential point.

Diaphragmatic hernia of the stomach and intestines from a crushing injury must also at times be considered in the differential diagnosis. In such a hernia the lung would be pushed upward rather than against the spine, and the breath sounds over it would be exaggerated and not amphoric or suppressed.

Subphrenic abscess due to ulceration of the stomach or bowel and containing gas may push the diaphragm high up in the chest and present the signs of pyopneumothorax. A history of abdominal trouble, harsh vesicular breathing in the lung above the abscess, great downward displacement of the liver, and but little displacement of the heart would, however, be of differential assistance.

The X-rays may be of much help in the diagnosis of pneumothorax. Characteristic in this picture are intense clearness over the pneumothorax and below this a dark shadow thrown by the exudate. The upper border of this shadow sinks and rises with respiration, and movement of this border can be obtained by breathing, change of position, and coughing.

ETIOLOGY.—Pneumothorax always results from perforation of the pleura and entrance of air through

the opening, except in rare instances in which the condition arises spontaneously, owing to infection of the pleura with *B. aërogenes capsulatus*, *B. coli*, or some other gas-producing organism. Pneumothorax is most frequent on the right side, in the male sex, and in adult life.

Pneumothorax from Disease of Thoracic or Abdominal Organs.—The commonest cause of pneumothorax is perforation of the pleura by a tuberculous focus in the subjacent lung. About 90 per cent. of the cases are ascribed to this cause. Even in tuberculosis the condition is encountered only in a small proportion of cases. The perforation generally occurs while the patient is at rest, not rarely during sleep, and in the absence of cough or violent respiratory effort. These are the conditions in which hemoptysis also occurs.

Of the remaining 10 per cent. of cases of pneumothorax, the greater number are due to ulceration of an empyema into a bronchus. Other, less frequent, causes are rupture of a gangrenous focus or abscess of the lung, of an echinococcus cyst, an emphysematous bulla, a bronchiectatic cavity or a bronchopneumonic focus, puncture of the lung by a fractured rib, and possibly rupture of lung held down by adhesions during violent coughing or physical exertion.

Pneumothorax may also arise through rupture of a cancerous growth of the esophagus into the pleura, or through perforation of the diaphragm by an abscess resulting from ulcerative disease of the stomach or colon, provided communication with these organs is preserved.

Sometimes pneumothorax develops

in persons otherwise apparently healthy; many of these cases are probably tuberculous.

Pneumothorax from without may be due to traumatic injury, as in stab or other wounds of the chest, or to an abscess in the chest wall opening both externally and into the pleural cavity. Many cases of circumscribed pneumothorax follow thoracentesis, but symptoms only infrequently arise therefrom, the entrance of an amount of air not exceeding the volume of fluid evacuated exerting no harmful effect.

PATHOLOGY.—Pneumothorax may be of the open variety, in which air enters and leaves the pleural cavity during inspiration and expiration, respectively; of the closed variety, in which the point of original entrance of air into the pleural cavity has become closed; or, of the valvular variety, in which usually the entrance but not the exit of air from the pleura is permitted. In the last-named type, whenever expulsive expiratory efforts, such as coughing, straining, or blowing, are made, air is forced through the valvular opening into the pleural cavity, the pressure there becoming as great as during the most violent of these efforts. The side may thus become greatly enlarged, the diaphragm pushed down until possibly the entire liver is below the costal border, and the heart and mediastinum pushed to the opposite side. Distention with air can be easily demonstrated at autopsy by introducing a small cannula, when the air will escape with more or less force, as may be shown by its effect on a lighted match or candle.

The point of rupture of the lung

varies in size. Often small at first, it usually becomes larger if the patient survives. Generally, it can be found at autopsy, if not by direct inspection, then after forcing air through one of the bronchi. It is most often found on the external or posterior surface, between the third and sixth ribs. It is in the acute forms or phases of tuberculosis that perforation oftenest occurs, caseous foci near the surface of the lung breaking down and necrosis of the overlying pleura taking place before time for adhesion to the parietal pleura has been given.

Pneumothorax may be circumscribed or diffuse. In the latter variety, the air in the pleural cavity may amount to 2000 c.c. or even more. The air may or may not be offensive in odor. In closed cases, the oxygen is gradually absorbed and the carbon dioxide and nitrogen increased. In the fetid cases, hydrogen sulphide is also present.

The condition of the pleura in pneumothorax is variable. It may present the normal smooth and shining appearance, but in most instances lesions similar to those of purulent pleuritis are found. The membrane may then be much thickened and covered with a thick layer of lymph, and the lung is apt to be adherent to the parietes in various places. While in rupture of a healthy or an emphysematous lung no exudation of fluid into the pleural cavity may occur, the frequency of pleuritis in cases of perforation due to ulcerative processes naturally involves the presence of fluid—sero-purulent or, more often, purulent—in addition to the air in the pleura. This may be present in such amount

as to exert a distinct effect in compressing and displacing thoracic or upper abdominal viscera. In traumatic as well as ulcerative cases, blood may also be found in the pleural cavity. In rare instances pneumothorax is bilateral.

PROGNOSIS.—This depends on the cause of the pneumothorax and the condition of the patient at the time. Recovery occurs oftenest in previously healthy subjects. In most other instances, however, including tuberculous cases, the prognosis is grave. West, collecting 160 cases of pneumothorax, found the mortality to have been $62\frac{1}{2}$ per cent. Much depends upon the condition of the opposite lung. If it is only slightly diseased, and the general condition is good, recovery may occur. On the other hand, where there is extensive tuberculous disease of both lungs, prompt death is the rule. In a few cases death occurs in some hours or days; in most instances—the rule in tuberculous cases—it takes place within a few weeks. In 39 cases Powell found the average duration of life to be twenty-seven days.

Among the factors upon which the prognosis depends are: the urgency of the symptoms, *i.e.*, the amount of dyspnea and cyanosis; the ability of the right heart to overcome the increased resistance in the pulmonary circulation, any sign of dilatation being unfavorable; the general strength of the patient—in particular the development of the respiratory muscles. The appearance of râles is a very bad omen (West).

Death may occur either from rapid suffocation or shock, as a result of effusion, or as a result of the

original disease process, *e.g.*, tuberculosis. The proportion of deaths is much greater during the first week than at any subsequent time.

In some cases of tuberculous pneumothorax the condition becomes chronic and does not terminate for months or years. In occasional cases a tuberculous condition in the lung is arrested by pneumothorax, as in cases of intentional artificial pneumothorax.

In traumatic pneumothorax the prognosis depends largely upon the nature of the injury.

Details of 25 cases, all showing that even a total pneumothorax causes no serious disturbances if it occurs slowly and gradually and if the other lung is working well. C. Liné (Arch. gén. de chir., Oct., 1908).

TREATMENT.—In cases where the onset is sudden, with severe symptoms, **morphine** should be given subcutaneously for the relief of the pain and dyspnea, as well as to allay mental distress. Stimulants, such as **caffeine** and **camphor** are usually required to combat the tendency to circulatory failure. Where cyanosis and dyspnea are great, **dry cupping** may give some relief. **Bromides** may be used if indicated. A generous nutritious **diet** should be given. The patient should be kept **quiet** and carefully watched. If no marked disturbances follow, no attempt should be made to evacuate the pneumothorax, as in a certain proportion of tuberculous, traumatic, or other cases, spontaneous absorption of the air in the pleural cavity takes place.

In the very acute “suffocative” cases, however, due to a valvular opening into the pleura, **thoracentesis** should be performed under strict

surgical precautions as soon as the diagnosis of pneumothorax has been made. The air should be allowed to escape through a cannula, without the use of suction, which tends to reopen the lung perforation where it has become closed. The paracentesis should be repeated, if necessary; or, **continuous drainage** may be practised, preferably by connecting with the cannula a rubber tube twenty inches long, with its distal extremity dipping into water in a test-tube, to prevent the drawing in of air into the pleural cavity, and to favor healing of the opening in the lung. Where simple paracentesis is practised, subcutaneous emphysema may follow removal of the cannula; this may be obviated by making pressure on the puncture for a short time.

For the pain caused by the pleurisy that usually follows the onset of pneumothorax, **cupping** may be resorted to, followed by **hot fomentations**, after which the **chest** may be **strapped**.

In tuberculous cases with a purulent pleural exudate the course may be chronic, without marked disturbance. Moreover, the compression of the lung by the pneumothorax may prove useful, leading to arrest of the tuberculous process. Thoracentesis or even free incision are likely to give but temporary relief, and the latter may lead to further infection and sepsis. Greater activity of the tuberculous process is also often excited. These cases are therefore best left alone,—unless serious dyspnea and cyanosis appear, or the seropurulent exudate present becomes excessive in quantity. Under the latter circumstances, **thoracentesis** should be performed, and later repeated if

necessary. **Siphonage** is generally considered preferable to aspiration, in that the danger of reopening the point of rupture in the lung and converting the closed pneumothorax into an open one is less. Where a true pyopneumothorax exists, with presence of a considerable quantity of pus, the treatment required is, as a rule, that of purulent pleuritis in general, viz., **incision** and **drainage** (see section on SUPPURATIVE PLEURITIS, in this article). The condition of the patient and, in particular, of his other lung, together with the chances of reopening the perforation in the lung and of lighting up a quiescent tuberculous process must, of course, be given due consideration in deciding whether to intervene. In operating, the sound side should always be turned upward, death from a flow of pus into the bronchi of the sound side having occurred in 2 cases in which the affected side was turned up to facilitate operation (Bowles). As in empyema, **rib resection** may be necessary, and subsequently **pulmonary gymnastics** should be systematically carried out to secure re-expansion of the lung.

In pneumothorax due to perforation of a bronchial tube by an empyema prompt **drainage** is urgently required. Where the fluid is putrefactive in character and fetid, the danger attending non-intervention is even greater, free drainage affording the best, if not the only, hope of relief.

In traumatic pneumothorax the chief danger is infection of the pleura. Where the pleura is manifestly infected, **drainage** should be provided for. If, on the other hand, the wound is apparently clean, the

opening in the chest wall, after disinfection of the wound, should be sealed, the pneumothorax being thus rendered a "closed" one.

In pneumothorax occurring accidentally during thoracentesis, due to forcing of air into the pleural cavity through the making of a wrong connection with the instrument, the air should immediately be allowed to flow out again by disconnecting the cannula and tube or by actual aspiration.

HYDROTHORAX.

This signifies a serous transudation into the pleural cavity, occurring independently of inflammation. It is also termed pleural dropsy or pleural edema.

SYMPTOMS.—The symptoms are such as result from interference with respiration and pressure on intrathoracic organs, viz., dyspnea, cyanosis, cough (sometimes paroxysmal), and circulatory insufficiency. These symptoms are likely to be referred to the primary disease, and the hydrothorax overlooked. Wherever such symptoms are met with in increasing intensity, pleural dropsy should be thought of and removal of the fluid effected if necessary.

The *physical signs* are those of serofibrinous pleuritis. Vocal fremitus is absent. The breathing may be bronchial on account of collapse of the air-vesicles; it is usually faint. On light percussion a dull note is obtained. There is no friction rub. Sometimes there is a crepitant râle over the upper part of the effusion and above it. The transudate, being more limpid and not held by adhesions, shifts more easily upon change of posture than that of pleuritis.

DIAGNOSIS.—In failing cardiac compensation especial subjective distress should suggest the thought of a right-sided hydrothorax. Confirmation of this suspicion is afforded by the physical signs of fluid in the pleural cavity and by examination of a removed specimen of the fluid.

ETIOLOGY.—Most cases of hydrothorax occur as a part of general dropsy, especially in cardiac failure, renal disease, and pulmonary emphysema with secondary heart-failure. In heart disease the condition is often limited to one pleural cavity, whereas in renal disease both are usually affected. An intrathoracic tumor may cause dropsy on one or both sides, from pressure on the azygos veins. Other conditions that may give rise to hydrothorax are: pernicious anemia, leukemia, scurvy, cachectic states such as attend carcinoma or sarcoma, any condition causing hydremia, and possibly also disease of the capillaries or toxemia.

PATHOLOGY.—The effusion consists of a clear, straw, or pale, amber-colored fluid, rich in albumin usually (1 to 3 per cent.)—richer than the dropsical fluids of the pericardium, peritoneum, or subcutaneous tissues. Microscopically, the fluid contains leucocytes, red cells, and an occasional endothelial cell.

In recent cases the pleura is normal in appearance, but after a time it loses its glistening appearance on account of a slow, low-grade inflammation. The pleural lymphatics may, by their dilatation, form a distinctly visible network. More or less pronounced collapse of the lung also occurs.

TREATMENT.—The treatment must be directed mainly to the cause.

In the cases of cardiac origin, any **improvement** procured in the **circulation** will usually cause disappearance of the pleural edema. If such improvement is not speedily secured, however, the fluid should be removed by **aspiration**, such removal in itself being sufficient to lead to a recovery of compensation, especially if the right ventricle be simultaneously relieved by **venesection**. **Digitalis** and similar drugs, if previously given without benefit, are then likely to become effective.

HEMOTHORAX.

This is the condition arising as a result of hemorrhage into the pleural sac.

SYMPTOMS.—The general symptoms of hemorrhage are present, and if the escape is rapid and large there is dyspnea in proportion to the pressure on the lung. Symptoms of pleuritis without fever or friction are present. The percussion note is absolutely flat when coagulation takes place, even if only in a thin layer.

Combination of the signs of loss of blood with those of a rapid accumulation of fluid in the pleural cavity are the chief diagnostic features of hemothorax.

ETIOLOGY.—Hemothorax may arise from traumatism or from rupture or erosion into the pleural cavity as a result of disease processes in neighboring tissues. In traumatic cases there may be rupture of an intercostal or mammary artery, or laceration of the lung, at times accidentally during aspiration. Rupture of an aneurism of the aorta into the pleural cavity, not infrequently occurs. Occasionally rupture of an aneurism of the internal mammary

takes place, and in rare cases there is rupture of a vein into the pleural cavity. Rarely bleeding occurs from rupture of a pulmonary infarct or of a tuberculous cavity. Hemorrhage into the pleura may also take place in scurvy and in purpura.

PROGNOSIS.—This varies with the origin of the bleeding, its amount, and the possibility of reaching the bleeding point by surgical means. In traumatic cases early coagulation takes place and the serum is rapidly absorbed; the clot is long, however, in disappearing. If infection occurs, suppurative pleuritis follows. Where the largest vessels are involved the prognosis is wholly unfavorable.

TREATMENT.—The treatment is expectant unless the bleeding point can be located and secured. Bleeding from the chest wall can be stopped by the application of a **ligature**, while in hemorrhage from traumatized lung-tissue recovery may occur if the patient be kept absolutely **quiet** and an **opiate** given. Caution should be exercised in operating when the source of the bleeding is not known. The danger of pneumothorax upon opening the pleural cavity can, however, be obviated by the use of **intratracheal insufflation**. If there is urgent dyspnea some of the blood should be removed by **aspiration**.

CHYLOTHORAX.

This condition occurs in two forms: (1) true chylothorax, in which true chyle from the thoracic duct is present in the pleural cavity; (2) false chylothorax, in which the fluid present is not chyle, but an exudate rendered chyle-like by the large number of contained fat globules, derived

from diseased pleural epithelium and pus-cells.

SYMPTOMS.—The symptoms are those of a non-inflammatory effusion or a pleural tumor. Pain may result from distention of the pleural cavity. Aspiration will determine the diagnosis, which is usually not made until this procedure is carried out; but there may be difficulty in withdrawing the fluid.

ETIOLOGY.—It is usually caused by obstruction of the thoracic duct or the receptaculum chyli, but may be due to rupture of either of them. In many cases the seat of lesion cannot be found at the autopsy. The obstruction may be caused by a cancerous growth or a tuberculous deposit. True chylothorax, which is a rare condition, is usually due to traumatic rupture of the thoracic duct or to obstruction of it or of the receptaculum chyli through pressure of external tumors or of tumors in these structures themselves. It may also be due to thrombosis of the left subclavian and internal jugular veins or to blockage by parasites. False chylothorax is an infrequent complication of carcinoma of the pleura and of tuberculous pleuritis.

PATHOLOGY.—Chyle differs from chyloform fluid in containing but 1 per cent. or less of fat, while chyloform fluid may contain 5 or 6 per cent. Its fat and protein granules are also likely to be coarser than those of chyle, while the latter is more likely to contain sugar. In either form of chylothorax, fluid of a similar nature may be present in the peritoneal cavity.

PROGNOSIS.—This is, on the whole, unfavorable, death generally occurring in six to ten months.

Spontaneous repair sometimes takes place in the traumatic cases. Attempts at surgical correction of the condition are not often attended with success.

TREATMENT.—This depends upon the cause of the condition and the symptoms produced. Where the accumulation of fluid induces pain, **thoracentesis** should be performed, repeatedly if required. In the cases of tuberculous origin this yields some hope of recovery. In cases due to cancer, on the other hand, none but palliative measures are available.

NEW GROWTHS OF THE PLEURA.

These may be primary, but the majority are secondary to neoplasms situated elsewhere. Most of the latter variety arise by direct invasion from a primary lesion in the lung; the remainder are secondary to new growths of the mammary gland, the liver, the kidneys (hypernephroma), and the lymphatics of the mediastinum.

Of the primary growths, endothelioma or endothelial carcinoma is the most common. Round or spindle-celled sarcoma may also occur.

Of benign tumors, lipoma, fibroma, and chondroma are sometimes met with.

SYMPTOMS.—These are decidedly variable, but in general resemble those of chronic pleuritis, with the addition, frequently, of more or less local pain or discomfort, with progressive loss of weight and strength, and anemia. Cough and dyspnea are generally present. Where a primary cancer of the lung has been followed by diffuse involvement of the pleura, the pleural manifestations may pre-

dominate and obscure the pulmonary disease.

The physical signs usually point to a pleural effusion of considerable extent, frequently with cardiac displacement. On inspection, the thorax may be found distended, markedly retracted, or irregularly distended and retracted. On inspection, dullness is to be expected, but it is likely to vary in intensity in different places and to be irregular in outline. Fremitus is diminished and the respiratory sounds weakened.

DIAGNOSIS.—Clinical distinction between pleural neoplasm and *chronic tuberculous pleuritis* is difficult until the condition is well advanced. The diagnosis is best reached by exploratory puncture, which, in the case of neoplasm, will yield a fluid typically blood-stained and containing tumor-cells, *e.g.*, sarcoma spindle-cells, or small bits of the growth, visible microscopically.

PATHOLOGY.—Pleural growths are usually soft and flattish, though causing a more or less pronounced thickening of the normally tenuous membrane. In most instances of endothelioma there is much thickening, due mainly, however, to inflammatory reaction rather than to the growth itself.

Metastasis to the lungs and to other structures may occur, and the growth may appear under the ribs and infiltrate the skin.

PROGNOSIS.—The prognosis of pleural neoplasm is unfavorable, death usually ensuing in a few months.

TREATMENT.—This is purely symptomatic, the condition not being amenable to curative treatment. Pain or discomfort should be relieved

with **opium** or **morphine**, and **thoracentesis** practised when fluid accumulation causes dyspnea; repeatedly if necessary.

ECHINOCOCCUS INFECTION OF THE PLEURA.

This condition is very rare, being met with primarily in the pleura in probably less than 1 per cent. of all cases; as a secondary infection, especially from the liver and lung, it is somewhat more frequent.

SYMPTOMS.—As in hydatid cysts of the liver the health may continue good. Pain, however, may be an early and persistent symptom. Pressure symptoms are added as the cyst enlarges, and the lung becomes compressed and the heart displaced. The temperature is normal unless inflammation develops. Anemia and loss of flesh may become marked. Occasionally there is hemorrhage into the pleural cavity.

DIAGNOSIS.—Diagnosis of the condition is usually difficult. Its presence is suggested by the evidence of a growing cyst without fever. Pain and loss of flesh may be present as additional indications. Tactile fremitus is absent. *Circumscribed pleuritis* and *new growth* of the pleura lead to similar symptoms, but may be differentiated by puncture and careful examination of the fluid for hooklets.

PATHOLOGY.—The cyst is usually single, growing inward from any part of the pleura. It compresses the lung and gives rise to the signs of a circumscribed pleural effusion, of which the outline may be irregular. In a few cases it grows outward and causes bulging of the chest wall and may perforate it, causing a chronic

fistulous opening. The cyst-wall is formed externally of the much thickened and dense pleura, and internally by the laminated membrana propria of hydatid cysts. The fluid contents are clear, though rarely they may become purulent from secondary infection (McPhedran).

TREATMENT.—The condition usually terminating in death if allowed to run its course, energetic treatment is indicated. Simple **aspiration** is rarely sufficient and, though direct drainage of the cyst with the trocar has been successfully procured, the mortality from this procedure has been too high to permit of its general employment. To secure the best results the cyst must be removed unruptured; this is best accomplished by free **incision** with **resection of ribs**. Cases promptly treated in this manner nearly always recover completely.

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PNEUMONIA, LOBAR.—Lobar pneumonia (croupous pneumonia; fibrinous pneumonia; pneumococcic lung infection; pneumonitis; lung fever) is an acute infectious disease due to the *Diplococcus pneumoniae* and characterized by pneumococci bacteremia and a special inflammation of portions of one or both lungs, proceeding to solidification.

SYMPTOMS.—The duration of the incubation period is believed to vary from some hours to several days. The prodromes are indefinite and, in fact, usually absent, the onset being generally sudden with a chill, often severe and lasting from one-half to one hour. In adults it is only occasionally

preceded by a day or two of ill health, featured by such manifestations as coryza and sore throat, anorexia, headache, dull pains in the extremities, and malaise. Sudden, pronounced thoracic oppression is the initial complaint at times.

Early in pneumonia, pain may be referred to the tip of the acromion because the phrenic sends communicating branches to the brachial plexus which supplies cutaneous branches to the tip of the acromion. A sense of constriction in the throat, with hoarseness, croupy cough, partial or complete aphonia, and sometimes inspiratory dyspnea, may also be complained of. Simonton (Trans. of the Med. Soc. of the State of Penna.; Jour. Amer. Med. Assoc., Nov. 1, 1919).

In children convulsions, vomiting, or delirium may replace the chill as the initial symptom. In some instances a gradual onset is noted, with indefinite, non-characteristic prodromal symptoms persisting for a few days to a week. Where bronchitis precedes the pneumonia, the onset of the latter may likewise be either gradual and insensible, or sudden and attended with a chill or some marked chest symptom. Such symptoms as cough, slight dyspnea, and pain in the thorax may be manifestations either of pre-existing bronchitis or of the incipient pneumonia itself.

After the chill, the temperature rises quickly, often attaining 104° F. (40° C.) in a few hours. The face becomes flushed, and a circumscribed, deep-red spot often appears on the side of the affected lung. Subjective complaints begin early on the first day, promptly after the termination of the chill. Pain on the affected side, especially during inspiration, is often a prominent symptom. A dry cough, half suppressed because

of the pain it occasions, soon sets in, greatly augmenting the patient's suffering. Headache and muscular pains are also likely to be complained of. Complete anorexia is usually noted, and often there is vomiting. Marked thirst appears, the skin is dry, the pulse rapid, the urine scanty, and the bowels generally inactive, though occasionally diarrhea occurs. Usually the patient lies on the affected side until the pain has largely disappeared.

On the second day the cough generally becomes more productive, a characteristically viscid, airless, tenacious, and rusty or blood-stained sputum being expectorated. At the same time the physical signs of lung consolidation usually appear, though in some instances—in central pneumonia especially—they may be delayed until the third day. The effects of general toxemia are also manifest in sleeplessness and delirium. On the second or third day, an eruption of herpetic vesicles about the lips and alæ nasi develops. The respiration becomes rapid and shallow owing to reduction of functioning lung-tissue by the pathological process. The resulting dyspnea may even be accompanied by cyanosis and suffusion of the conjunctivæ.

In from five to nine or ten days the febrile movement generally terminates by crisis,—sometimes accompanied by abundant sweating or diarrhea,—after which convalescence, as a rule, becomes rapidly established.

Symptoms in Detail.—*The Fever.*—In typical cases the temperature, after quickly rising to 104° F. (40° C.) or over, remains high until the crisis. For two or three days it may not vary more than 1° F. during the twenty-four hours. Slightly larger

remissions during the night are then likely to occur. Often, preceding the crisis by a day or two, and occasionally even earlier in the course of the disease, there is noted a fall in temperature to between 99° and 101.5° F. (37.2° and 38.5° C.),—a pseudocrisis,—followed by a return to the previous level. In some cases the temperature rises just before the crisis even above its previous level—the precritical rise. Such a rise may, on the other hand, be the forerunner of death; though in the majority of instances death is preceded by a fall in temperature. The crisis may take place anywhere between the third and the fourteenth day; typically, it occurs on the seventh or the ninth day. It consists in a drop of temperature to normal, or more frequently below normal, taking place usually at night, accompanied by sweating, occupying two to twelve hours, and followed by symptomatic relief and usually a prolonged, refreshing sleep.

Elsner found the initial chill absent in 14 per cent. of 150 cases of croupous pneumonia occurring in adults. In debilitated or old persons, as well as in drunkards, the temperature is not likely to rise so high as in previously robust and normal persons, averaging 102° or 102.5° F. (38.8° or 39.1° C.). In some instances—afebrile pneumonia—there is no rise in temperature. On the other hand, in some cases the temperature may be unusually high— 106° or 107° F. (41.2° or 41.8° C.)—throughout the disease. The critical period may be unduly prolonged, lasting twenty-four hours or more; or, not infrequently owing to some complication, or where the disease persists after

the tenth day, the temperature decline may be by lysis. A slight post-critical rise in temperature may be noted.

Respiratory System.—The rate of respiration typically rises to 30 or more per minute on the first day, and later attains 40 to 60 in adults and 60 to 100 in children. At first superficial and repressed owing to pain, it may later become panting, especially in old patients. Accompanying expiration is an audible "grunt," considered almost pathognomonic of the disease. Actual dyspnea with air hunger is frequently present, owing to reduction in functioning pulmonary surface through solidification of portions of the lung, but at times no lack of oxygen exists and the increased respiratory rate may be due to the action of toxic bodies in the blood on the respiratory centers, subsiding promptly at the crisis in spite of persisting impairment of pulmonary functioning. Other possible causes of rapid breathing are associated general bronchitis, heart-failure, pericarditis, and pleural effusion. Commonly the pulse respiration ratio becomes 2 to 1 instead of the normal 4 to 1.

Stab-like pain in the affected side is a constant symptom where the pulmonary lesion extends to the periphery of the lung, and is usually ascribable to inflammation of the pleura. It is usually referred to the region of the nipple or to the axilla or lower ribs of the involved side; less frequently to the abdomen, to a point below the scapula, or to the opposite side. Occasionally, the reference of pain to the abdomen is so marked that a wrong diagnosis or even an operation for appendicitis is

determined on. The pain is greatly intensified by coughing or deep breathing, but gradually disappears after being present for two or three days. In aged and markedly toxemic cases it may be absent.

Cough is another very constant symptom, though occasionally absent in drunkard, adynamic, or aged cases. At first short and unproductive, and probably arising through the bronchitis associated with the pulmonary lesion, it soon becomes less harsh, owing to the elimination of sputum, at first mucoid and frothy. In a few hours, the sputum becomes reddish or yellowish red and characteristically viscid, adhering to the receptacle even when it is inverted. In aged and alcoholic cases the sputum may be of the "prune-juice" variety, *i.e.*, thinner and darker in color, owing to greater admixture of blood. It may even be frankly hemorrhagic in severe cases, and in a few instances exhibits a greenish color. About the time of the crisis the sputum generally becomes more or less purulent in appearance, less viscid, and hence more easily expelled. In adynamic cases and in the very young and very old, the sputum may be scanty or absent throughout the disease.

Microscopic examination of pneumonic sputum reveals the *Diplococcus pneumoniae*, frequently in association with other micro-organisms, numerous more or less degenerated erythrocytes, epithelium from the pulmonary alveoli, pus-cells, mucus, and sometimes small fibrinous plugs and casts from the air-cells and bronchi. At times the reddish coloration of the sputum is due solely to dissolved blood-coloring matter,

the erythrocytes themselves having broken up.

Suffocation from falling back of the base of the tongue was observed by the writer in a mild pneumonia. No edema, paralysis or tumor could be discovered. The symptoms suggested those observed when the root of the tongue relaxes under an anesthetic, and the treatment indicated proved successful. Jorgensen (Ugeskr. f. Laeger, Aug. 9, 1917).

The writer studied the respiratory rate and found that in proportion as it was increased there was a gradual decrease in the volume of air expired. The anoxemia in acute lobar pneumonia is the result of the rapid and shallow breathing typical of this disease. J. Meakins (Arch. Internal Med., Jan. 15, 1920).

Circulatory System.—In the average case of lobar pneumonia in the adult the pulse rate is 100 to 110 or 120. The rate usually corresponds to the intensity of the disease, and where a rise above 120 takes place cause for apprehension exists. At first the pulse is full and bounding, but later, when consolidation is extensive and especially where the disease is severe, it becomes small, feeble, more rapid, frequently irregular, and occasionally dicrotic.

The blood-pressure, at first normal, begins to descend in three or four days. According to MacKenzie a fall of the pressure, recorded in millimeters of mercury, below the pulse rate per minute implies danger.

In patients who are non-alcoholic, even those of advanced age, Gibson's rule that when the pulse rate per minute is higher than the pressure of the millimeters of mercury the equilibrium of the circulation is seriously disturbed and the prognosis less favorable, seems to hold particularly true. A. Lambert (Jour. Amer. Med. Assoc., Dec. 2, 1911).

The heart sounds in pneumonia are typically definite and clear. The pulmonary second sound is accentuated owing to increased blood-pressure in the pulmonary system, due, in turn, to the consolidation of lung-tissue. Low-pitched, functional murmurs at the mitral and tricuspid valves are common at the height of the disease, the myocardium being weakened through toxemia and the pressure in the pulmonary circulation excessive. Where serious impairment of cardiac power occurs, especially in the overtaxed right ventricle, the intensity of the first sound promptly diminishes and the previously accentuated pulmonary second sound becomes indistinct; later, there may be extension of heart dullness to the right, embryocardia, epigastric pulsation, and cyanosis. Excessive toxic action on the vasomotor center also not infrequently results in sudden circulatory insufficiency. Collapse from heart-failure is especially to be apprehended at the critical period.

Blood.—Leucocytosis, beginning with the onset of the disease and persisting until just before the crisis, is a feature of most cases of pneumonia. The usual number of leucocytes is 15,000 to 45,000. A slight leucocytosis, though at times occurring in mild cases, is usually an unfavorable prognostic sign, and is met with chiefly in cases with marked toxemia and asthenia. Other blood-changes include: Reduction or absence of eosinophiles during the height of the disease, with reappearance at or just before the crisis; a marked decrease in the red cells and hemoglobin after the crisis; an increase in the blood-plates and shortening of the coagula-

tion time, and, under certain circumstances, the presence of the pneumococcus. In cases terminating by lysis, the decline from the characteristic leucocytosis is gradual instead of sudden. A leucopenia may be met with in malignant cases of pneumonia.

Nervous System.—Headache may be a persistent symptom in pneumonia. In mild cases mental dullness or slight mental wandering, together with prostration, complete the nervous effects of the disease. In more severe cases there is often a constant delirium, generally of the low, muttering variety, but occasionally maniacal. Meningeal inflammation is at times found *post mortem* to account for the severe mental disturbance in these cases. In drunkards true delirium tremens is apt to develop, sometimes as the initial manifestation of the disease. In children convulsions at the onset are frequently encountered, and the disease may even run its course as a meningitis. In some instances mental symptoms begin about the time of the crisis, and persist for some days thereafter.

Alimentary Tract.—Vomiting is a frequent symptom at the outset, especially in children. Anorexia exists and the thirst is pronounced. The tongue presents a yellowish-white coating; it may later become brown, dry, and possibly fissured. Constipation is the rule, though diarrhea is at times met with. Tympanites may develop, owing either to toxic intestinal paresis or to a pneumococcic enteritis or colitis. The spleen is generally palpable and the liver may be displaced downward, especially in right-sided pneumonia.

Skin.—Herpes is an important symptom, occurring in approximately one-third of the cases on the lips and alæ nasi, and generally appearing on the second to the fourth day. Sometimes the herpes appears in successive crops. Occasionally it is encountered on the cheek, ear, tongue, forearm, or genitals. A dusky flush may be witnessed on one or both cheeks. Sweating may be abundant at the crisis.

Kidneys.—The urine is diminished in amount, of high specific gravity, highly colored, and contains a marked excess of urates and uric acid. Albuminuria is frequent, and occasionally acute nephritis occurs. In most but not all instances, the chlorides in the urine are greatly reduced in amount or absent; this is presumably due in part to a diminished intake of salt, the result of anorexia, and in part to accumulation of chlorides in the lung-exudate.

In pneumonia caused by the Friedländer bacillus herpes and chill are often absent; the temperature may be low despite obvious severity of the disease. The sputum is abundant, mucoid, viscid, and varies in color from gray to brownish red. Microscopically, an enormous number of bacilli can generally be found, while in diplococcus pneumonia the germ may be very difficult to detect. In about 50 per cent. of cases, there is rapid softening of the central portions of the infiltrated lung-tissue. The course of the disease is protracted beyond the crisis and the patients often die as a result of heart-failure or exhaustion. Often an abscess of the lungs develops. Where there is a double infection with pneumococci and Friedländer bacilli, the latter generally gain the upper hand in a short time, so that the pneumonia runs the course of a bacillus infection. Wherever a pneumonia is slow to resolve

and the prognosis seems to be bad despite low temperatures, a bacillus infection should be suspected and the sputum examined. Toenniessen (Münch. med. Woch., Dec. 5, 1911).

Physical Signs.—Stage of Congestion.—*Inspection.*—Expansion is often much diminished on the affected side, especially in case of basal involvement, though no change in the contour of the thorax can be perceived. This limitation of respiratory movement is ascribed to involuntary fixation of the chest wall because of the severe pleuritic pain. For the same reason the patient often lies on the affected side, to minimize rubbing together of the visceral and parietal pleura. The rate of respiration is increased. In bilateral pneumonia, costal breathing, with pronounced movements of the abdominal muscles, is noted.

Palpation.—Tactile fremitus over the congested pulmonary segment is slightly increased.

Percussion.—The percussion note, as the lung becomes engorged, is usually higher pitched than normal and may actually possess a tympanitic quality (Skodaic resonance). At times the percussion note is normal.

Auscultation.—Respiratory sounds are feeble or bronchovesicular,—the latter upon deep inspiration. Over the uninvolved lung-tissue exaggeration of the breath sounds is likely to be noted. Shortly after the onset—usually at the close of the stage of congestion, which lasts about twenty-four hours,—the characteristic crepitant râle may be detected, especially at the end of a full inspiration. Various other râles, coarse or fine and moist or dry, may be heard over both lungs, where, as is frequently the case, acute bronchial catarrh coexists.

At the termination of the congestive stage a friction rub, due to deposition of a layer of fibrin on the pleura, may be heard.

A localized deficiency of the breath sounds is a commoner and more valuable sign of commencing pneumonia than the crepitant râle of Laennec or the fine hair crepitation. The latter may be confounded with the fine crepitation of edema, and is often not heard at all in cases carefully watched from the first appearance of physical signs. P. Kidd (Lancet, June 22, 1912).

Stage of Consolidation.—*Inspection.*—Expansion over the affected area is greatly reduced or quite absent, owing to solidification of the lung; on the uninvolved side it is augmented. Mensuration may show enlargement of the affected side to the extent of 1 or 1½ cm., but the natural depressions between the ribs persist. Undue limitation of functioning lung-surface by the disease process may become manifest in dyspnea, activity of the auxiliary muscles of respiration, dilatation of the nostrils, and cyanosis, most marked in the cheeks (sometimes unilateral cyanosis on the involved side) and lips.

Palpation.—Tactile fremitus is much increased, unless pleuritis with effusion coexists or the bronchi are closed by mucus or fibrinous exudate.

Percussion.—Dullness varies from a slight grade in the first stage to marked dullness when complete consolidation has occurred. The dullness is most pronounced posteriorly and is unchanged by full inspiration. There is increased resistance to the percussing finger, but this is not as marked as in pleural effusion. Anteriorly the note may be somewhat

tympanitic, owing to the proximity of the larger bronchi. Flatness may be noted in massive pneumonia (with the large bronchi plugged by exudate) or if pleuritis sufficient to cause effusion exists. Dullness is less marked in the very young and in the aged. The portion of lung just above the consolidated segment is apt to yield a note with a tympanitic quality (Skodaic resonance).

Auscultation.—Over the consolidated lung-tissue bronchial breathing is heard, unless the large bronchi are plugged with exudate, when it is absent. The voice sounds assume the qualities peculiar to bronchophony, or may even possess the bleating and nasal characteristics of egophony. The crepitant râle typical in beginning consolidation soon disappears, but subcrepitant râles, both dry and moist, due to coexisting bronchitis, can often be very distinctly heard because of the consolidation. Unaffected lung-tissue manifests exaggerated vesicular breathing through compensatory functioning.

Stage of Resolution.—*Inspection.*—Expansion on the affected side gradually returns, air re-entering the alveoli.

Palpation.—Tactile fremitus becomes progressively less.

Percussion.—Dullness gradually lessens, the note becoming more tympanitic and eventually resonant, though the impairment of resonance at times persists for a long period after seeming recovery.

Auscultation.—The breath sounds gradually become bronchovesicular and eventually vesicular. As the exudate liquefies, loud, moist râles, fine as well as coarse, make their appearance, and the crepitant râle, pre-

viously lost, may return (crepitus redux).

In some cases of pneumonia the appearance of the physical signs is greatly delayed, occasionally until nearly the time of the crisis. In some instances even they never appear, though the symptoms point to lobar pneumonia as the condition present.

CLINICAL VARIETIES OF LOBAR PNEUMONIA.—**Central Pneumonia.**—In this variety, the pneumonic process beginning in the center of a pulmonary lobe and gradually extending to its periphery, the physical signs are at first indefinite. Either the diagnosis is made mainly on the symptoms—pain, however, being usually absent owing to lack of pleural involvement—or the disease runs its course wholly, or at least for a certain period, unsuspected (latent pneumonia).

Apical Pneumonia.—This is common in children, is often very grave, and is more likely than ordinary basal pneumonia to be attended with marked nervous phenomena, especially delirium. By reason of the slight cough and expectoration this variety of pneumonia often remains undetected.

Massive Pneumonia.—In this form there is involvement of the whole or nearly the whole of a lung, with extension of the fibrinous exudate from the alveoli into the bronchi. The physical signs simulate pleural effusion, tactile fremitus and breath sounds being absent and the percussion note flat. Coughing is sometimes followed by expectoration of the exudate in the bronchi, the typical, pneumonic, physical signs thereupon suddenly appearing and the diagnosis being cleared up.

Migratory Pneumonia.—In this form, also termed wandering or creeping pneumonia, different segments of one or both lungs are successively involved. The onset of the condition may have been gradual, exacerbation of the symptoms occurs at the time of migration, and lysis generally replaces crisis.

Double Pneumonia.—One or more lobes of both lungs are involved, without any special modification of the symptoms. In “crossed” pneumonia, the lower lobe of one lung and the upper lobe of the other are involved.

Abortive Pneumonia.—In abortive, or larval, pneumonia the typical chill, fever, and cough are followed by crisis and recovery in one to a few days. Râles and signs of pleural involvement are often noted, but pure bronchial breathing is rare. The sputum may not be “rusty.” This variety occurs oftenest during epidemics.

Typhoid Pneumonia.—This refers to a serious form of the disease accompanied either by marked asthenia or by “typhoid” symptoms, viz., low, wandering delirium followed by gradually deepening stupor, extreme prostration, dry and frequently brown tongue, ataxic nervous phenomena, and tympanites. The onset is rather gradual, and the physical signs may be ill-defined; or, symptoms of the lung lesion may be lacking, the diagnosis depending upon systematic examination of the chest. The condition is met with among persons already weakened by disease or alcoholism, and may follow septicemia, chronic nephritis, and diabetes mellitus.

Typhoid pneumonia is also at

times used to designate a typhoid or a pneumococcic infection of the lung occurring in the course of typhoid fever. To the former condition the term “pneumotyphoid” is more properly applicable.

Epidemic Pneumonia.—The epidemic may be widespread or restricted to a single family, tenement house, ship, jail, or other institution. The condition not infrequently complicates influenza and its course is apt to be protracted and the mortality rate high. The physical signs may be slight or resemble those of bronchopneumonia. The so-called “serous pneumonia” complicating influenza is often characterized by sweats and irregular fever, and is ascribed to streptococcic infection.

Bilious Pneumonia.—Bilious or malarial pneumonia is a form occurring especially in malarious regions, with jaundice, vomiting, and severe nervous manifestations as its most striking features.

Alcoholic Pneumonia.—Pneumonia in alcoholics is insidious in onset and exhibits a comparatively low temperature range—from normal temperature up to 102° F. (38.8° C.). Pain may be almost wholly lacking and cough slight, but the sputum is not infrequently abundant and watery, with “prune-juice” characteristics.

There is often profuse sweating, and marked nervous symptoms are quite common. Delirium may be of the muttering or the maniacal variety; or, all the manifestations of delirium tremens may occur at the onset, with entire absence of the ordinary subjective symptoms of pneumonia. The prognosis is relatively unfavorable.

Postoperative Pneumonia.—Postoperative or ether pneumonia occasionally occurs, especially after abdominal operations. The condition often presents characteristics of lobular rather than lobar pneumonia, and is frequently due to bacteria other than the pneumococcus. Its development is favored by protracted anesthesia, pre-existing coryza, bronchitis, or chronic pulmonary congestion, general weakness, the winter season, and the inhalation of irritant substances.

Pneumonia in Children.—In children and infants a convulsion often marks the onset of the disease. Delirium and stupor appear earlier and more frequently than in adults. Vomiting is also more frequent. Pain is often absent or referred to other regions of the body, sometimes suggesting appendicitis, and expectoration, with the characteristic rusty color, is rarely available as a differential sign. The disease is apical oftener than in adults, but this localization is frequently overlooked.

Pneumonia in the Aged.—The onset is usually insidious, the initial chill being often absent or replaced by less pronounced chilliness occurring repeatedly. Prostration is marked. Pain, cough, and expectoration are slight or absent, and the physical signs are ill-defined. Death frequently occurs in the course of an apparently mild illness, owing to cardiac weakness. In my opinion, this is not a true pneumonia, but mainly a passive hyperemia due to failure of the sympathetic vaso-constrictors, which control the calices of the pulmonary arterioles.

Terminal Pneumonia.—Pneumonia often closes the scene in chronic nephritis, pulmonary tuberculosis, or-

ganic heart disease, diabetes mellitus, and chronic nervous diseases. No clinical evidences of the disease may be manifest other than a slight rise in the temperature and respiratory rate, and the physical signs of lung consolidation. The onset is gradual and the actual condition usually a bronchopneumonia.

Secondary Pneumonia.—This occurs in the course of many of the acute infectious diseases, and may be due either to the pneumococcus, to the organism responsible for the primary disease, *e.g.*, the typhoid or diphtheria bacillus, or to mixed infection with the common pyogenic organisms or the colon bacillus. The condition sometimes presents the characteristic features of lobar pneumonia, but is oftener a bronchopneumonia. Post operative pneumonia belongs to this class.

Study of 97 cases of postoperative pneumonia occurring among 3719 postoperative patients, with a mortality of 2.3 per cent. Many are discoverable by the X-rays long before frank signs of consolidation appear. There is a rise of temperature within 48 hours after operation, unaccompanied by a chill. There is usually a moderate cough. The temperature continues high for a day or two and then drops by lysis. During the first few hours of the initial high temperature the röntgenogram shows a shadow in the lungs, usually in one of the lower lobes. At this time the only physical signs are dullness with diminished breath sounds. Bronchial breathing does not appear until 24 hours after the appearance of the shadow and after the drop in temperature. A. C. Whipple (Amer. Assoc. of Anesth.; Jour. Amer. Med. Assoc., July 6, 1918).

DIAGNOSIS.—In the majority of cases of lobar pneumonia, the diag-

nosis is readily made, the sudden onset with a chill, the excessive respiratory rate as compared with the pulse, the cough and rusty sputum, the herpes, the leucocytosis, the temperature curve, and the physical signs admitting of no error when collectively noticed. The association of undue dyspnea with fever should always suggest examination of the lungs; likewise, the association of fever with delirium tremens in alcoholics.

Puncture of the lung in pneumonia, cautiously done, is a harmless way of verifying the bacteriological diagnosis and obtaining material for **vaccine therapy**. The findings show the state of the process and its gravity. Large numbers of diplococci in the fluid are a bad sign. Bertolini (Gaz. degli Ospedali, July 15, 1913).

A triangular cortical area of consolidation, discernible by radioscopy, frequently occurs in the complete absence of auscultatory physical signs in pneumonia. This is explicable through the newer view that the initial stage of pneumonia is one of general infection, local manifestations appearing later. E. Weill and G. Mouriquand (Lyon méd., Jan. 26, 1913).

About 80 per cent. of cases of pneumonia run a typical course and are readily recognized. The remaining 20 per cent. may, however, be quite atypical and even show practically no classical sign. In children apex pneumonia is apt to show symptoms suggesting meningitis; such diagnosis has been made. In double pneumonia we usually find 1 lung invaded 1 or 2 days after the first. This second invasion, however, is not as a rule attended by chill, nor necessarily with increased toxic symptoms. Croupous pneumonia of childhood is often different from that seen in adults; it is pseudolobar in type and characterized by markedly nervous symptoms, often simulating menin-

gitis. The character of pneumonia in the alcoholic is dependent upon whether it occurs in the steady drinker or the subject of an alcoholic debauch. In the former the onset might be quite characteristic, but the tendency to development of nervous and uremic symptoms sometimes complicates the clinical picture. In the steady drinker the clinical picture may soon take that of delirium tremens. The intercurrent pneumonias seen in the acute infections such as typhoid, diphtheria or influenza, are apt to be due to the specific organism of those diseases and differ in type from the ordinary croupous pneumonia as seen when due to the pneumococcus. Ross V. Patterson (Trans. Phila. Co. Med. Soc.; N. Y. Med. Jour., Apr. 27, 1917).

Abdominal pain is sometimes an early sign. In the case of a young man, pneumonia started with such distressing vomiting and intense abdominal pain that death seemed imminent, but he had quite recovered by the end of the second week. Clark (Brazil Medico, Dec. 7, 1918).

The conditions most frequently requiring differentiation from lobar pneumonia are: Bronchopneumonia, acute pulmonary tuberculosis, pleuritis with effusion, typhoid fever, and meningitis.

Bronchopneumonia. — This disease involves both lungs and lacks the definitely lobar physical signs of croupous pneumonia. Areas of dullness over which bronchial breathing and bronchophony are heard occur here and there on both sides. The onset is less sudden, a well-defined bronchitis generally preceding. There is not the characteristic rusty sputum. The disease is of longer duration and terminates by lysis.

Knowledge of the possible deviations from typical lobar pneumonia considered in the preceding section—

such deviations often tending toward the bronchopneumonic type—should prove sufficient, in conjunction with systematic chest examination, to keep one constantly on guard against oversight of the existence of a pneumonic lesion.

Acute Pulmonary Tuberculosis.—Often the existence of this condition instead of pneumonia is not suspected until failure of the expected crisis to occur is noted, or tubercle bacilli and elastic fibers are accidentally discovered in the sputum. Among the features which should suggest tuberculous rather than pneumonic disease are: Inherited predisposition to tuberculosis; previous ill health; gradual onset; fever of the remittent or intermittent type; frequent profuse sweats; more purulent and less viscid sputum, which may be blood-tinged, but contains numerous tubercle bacilli and yellow elastic tissue; absence of herpes; rapid emaciation, and the physical signs of cavity formation. The ratio of pulse to respiratory rate is, in general, less decreased than in pneumonia. The physical signs are, as a rule, first referable to the apex instead of the base, and invasion of the apex on the opposite side usually occurs.

Pleuritis with Effusion.—Difficulty in diagnosis arises especially in cases of pleural effusion with pronounced bronchial breathing and bronchophony. The differential features of effusion are as follows: The initial chill is usually not severe, often a mere chilliness; the temperature rarely rises above 102° F. (38.8° C.); usually there is less cough and less abundant expectoration; the characteristic rusty quality of the sputum is lacking; inspection of the chest reveals a change in the contour of the affected side, with

partial effacement of the intercostal spaces; the tactile fremitus is usually absent instead of increased; the percussion note is completely dull or flat; in left-sided pleural effusion there is displacement of the heart to the right and of the fundus of the stomach downward, with resulting obliteration of Traube's semilunar space; in right-sided effusion there is displacement of the heart to the left and of the liver downward; on auscultation the breath and voice sounds in pleural effusion are usually of reduced intensity or exhibit a distant bronchial quality.

Value of Pitres's sign for distinguishing between pneumonia and pleural exudate confirmed. An assistant strikes 2 copper coins together over the suspected area. The physician listens with one ear over the symmetrical point on the opposite side of the chest and the other ear occluded. If there is fluid between the 2 points, the sound is transmitted with a metallic clang; if there is normal tissue it is dull, and if pneumonic consolidation is present it is still duller. Ostrowski (Jahrbuch f. Kinderheilk., Sept., 1913).

Pneumotyphoid.—Differentiation of typhoid pneumonia from typhoid fever with lung involvement is often very difficult at first. It should be borne in mind that whereas leucocytosis is the rule in pneumonia, there is a leucopenia in typhoid. The result of the Widal test should be carefully noted. After the first week unmistakable symptoms of typhoid fever will appear in pneumotyphoid.

Meningitis.—Marked nervous symptoms in pneumonia at times lead to confusion between this disease and meningitis. Physical examination of the chest in all cases simulating meningitis is therefore advisable. Convulsions, while often the initial symptom

of pneumonia in children, usually occur only later in meningitis. Headache, which is frontal in pneumonia, is occipital in meningitis. Indicative also of the latter disease are: Restlessness, hyperesthesia, and exaggerated reflexes; rigidity of the neck; a lower, less regular temperature curve; a more variable and irregular pulse rate, and an absence of dyspnea as well as of the crisis.

ETIOLOGY.—Pneumonia prevails in all climates and occurs in all seasons, though especially during the winter and early spring. In cold weather with marked variations in temperature and humidity the incidence is greater than during protracted cold.

The disease occurs at any age, though less frequent in adolescence than at any other period. After the sixtieth year pneumonia claims more deaths than any other acute disease. Males, owing to greater exposure, are more liable to the disease than females. Sex in itself affords neither immunity nor any special predisposition to pneumonia. Negroes are more susceptible to the disease than whites.

Of 12,098 cases of pneumonia, 8881, or 73.41 per cent., occurred in males, and 3217, or 26.59 per cent., in females. Among 10,159 cases, the disease terminated by crisis in 5397, or 53.1 per cent.; in 1042 cases, 21.7 per cent., the crisis occurred on the seventh day; in 625 cases, from the tenth to the seventeenth day. Among 2613 cases death occurred as follows: Before the fourth day, 161 cases; fourth to twelfth day, 1483; twelfth to eighteenth day, 403 cases. The greatest number of deaths occurred on the seventh day. H. E. Lewis (Amer. Med., Apr., 1910).

Though common in individuals apparently in good health, the disease is most likely to attack those exposed to

depressing influences, either physical or mental. It is especially rife among individuals weakened by fatigue, insufficient food, faulty hygienic environment, exposure to inclement weather, and alcoholism, either acute or chronic. The more enfeebled the constitution, the more asthenic, as a rule, the form of the disease. Pneumonia often follows "catching cold," owing to the associated lowering of the resisting powers; in many cases, however, no history of exposure to cold is obtainable. Traumatism to the chest predisposes to it, and likewise convalescence from certain diseases, *e.g.*, typhoid fever, influenza, nephritis, and diabetes.

Study of 1000 consecutive laparotomies as regards postoperative pneumonia. Postoperative pulmonary complications are most liable to develop in cases in which there is sepsis present, and in which some trauma has been done, not to the air passages, but to the peritoneum. Clean cases are nearly as liable to pulmonary complications as septic, but the mortality is practically *nil* and the cases themselves are of atypical form and much less severe. Previous pneumonic processes do not light up again after ether. Lung complications are more common during the winter months. E. S. Risley (Boston Med. and Surg. Jour., Jan. 20, 1910).

Pneumonia occurred in 17, or 10.7 per cent., of 160 cases of heat prostration. Reid (Boston Med. and Surg. Jour., Aug. 15, 1912).

Malaria seems to favor the development of a latent pneumococcus infection. Lofforgue (Revue de méd., Apr., 1913).

In 90 cases of pneumonia in an infantry battalion at Camp Wheeler, the writers found that 60 per cent. occurred in tents containing over 1 case. The type of pneumococcus was practically always the same for any 1 tent. Carriers must therefore play

an important part in the spread of pneumonia. They then studied 700 men of the same regiment to find out the number of carriers. Of these, 16 per cent. harbored pneumococci. Over 3 per cent. showed pneumococci of one or the other fixed types and 12 per cent. were carriers of type IV pneumococci. All these men (111 in all) were placed in wards in the hospital in various groups, and attempts were made by various means to rid them of pneumococci. Solutions of **phenol** (phenol 3 per cent. in alcohol) and **iodin** (5 per cent. in alcohol) were the most valuable. These were applied as throat swabs and also dropped into the nostrils each day. In epidemics of pneumonia or of other diseases complicated by it this method of detecting and sterilizing carriers would be practicable. Sailer, Hall, Wilson and McCoy (Arch. Internal Med., xxiv, 600, 1919).

Epidemics of lobar pneumonia are sometimes met with, due to increased virulence of the organism. In the house-epidemic form the view that the disease may be transmitted by contagion is by some entertained. No immunity is conferred by one attack, which, in fact, seems to predispose to subsequent attacks.

The exciting cause of the disease is, in about 80 per cent. of cases, the *Diplococcus pneumoniae*, or pneumococcus of Fränkel (also known as the *Micrococcus lanceolatus*). The organism is a slightly elliptical coccus, united in pairs, and surrounded by a pale capsule, and was found by Netter in the buccal secretions of 20 per cent. of well persons. Its presence has also been frequently demonstrated in the nasal secretions and the Eustachian tubes. Under abnormal conditions it may be found in the blood as well as in various complicating or even independent lesions, such as pleuritis,

pericarditis, endocarditis, peritonitis, meningitis, nephritis, conjunctivitis, synovitis, and acute abscess.

Bacteriologic researches have shown that four types of pneumococci (types I, II, III and IV) prevail in adults, and also, as shown by A. G. Mitchell (Penna. Med. Jour., Feb., 1917) in infants and children, the so-called fixed types being infrequent in them as compared with adults. The pneumococci without definite agglutination reactions, and classed as Type IV, are of more frequent occurrence in infants than in adults. The mortality of infants and children infected with the fixed types (I, II, III) seems to be lower than in adults. The fixed types occur at all ages from 6 months to 11 years. Type IV pneumococcus often causes as severe an infection as the fixed types. Type I seems to cause a mild infection. Type IV is the most frequent infecting organism in bronchopneumonia, although the fixed types may also be found. Complications are more frequent with Type IV infection.

In the remaining 20 per cent. of lobar-pneumonia cases a pathological condition not infrequently indistinguishable from the pneumococcic form is caused by one of a variety of microorganisms, including the pneumobacillus, of Friedländer, the influenza bacillus, the typhoid bacillus, streptococci, staphylococci, the diphtheria bacillus, the plague bacillus, etc.

Infection with the pneumococcus is believed usually to take place by inhalation. Transmission may occur either directly, through a third person, or by the air, less frequently by fomites. If direct infection of the blood takes place through a wound or tonsil, the lung may be infected secondarily from

the blood. There is no constant relation between the amount of lung-tissue involved and the intensity of the symptoms; a limited pulmonary lesion may be attended with high fever and great constitutional disturbance, or an extensive lesion with relatively mild symptoms. To the more or less pronounced general toxemia induced by the organisms pullulating in the lung are due these variations in the severity of the symptoms.

The importance of a predisposing cause such as low vitality or previous local irritation in the production of the disease is emphasized by the experiments of Dürck, who showed that while intratracheal injection of the pneumococcus or other bacteria alone is insufficient to cause pneumonia, the latter results when irritating dust is also injected.

PATHOLOGY.—The essential lesion of lobar pneumonia is a temporary solidification of lung-tissue due to the deposition of a fibrinous, hemorrhagic exudate in the pulmonary alveoli and bronchioles. As a result, the lung is changed from an air-containing structure to one which is airless except in the larger bronchi. The right lung is oftener involved than the left, and the lower lobes oftener than the upper. Though not infrequently bounded by the fibrous septa separating pulmonary lobes, the lesion often extends beyond the limiting surfaces of a lobe. In a series of cases analyzed by Thomas G. Ashton the involvement was distributed as follows:—

	Cases.
Right lower lobe	83
Left lower lobe	59
Right upper lobe	24
Left upper lobe	14
Right middle lobe	3
Right middle and lower lobes .	20

	Cases.
Right middle and upper lobes .	9
Entire right lung	20
Entire left lung	18
One lobe in each lung (various combinations)	10
Right upper and middle and left upper lobes	3
Entire right lung and one lobe of left	9
Entire left lung and one lobe of right	8
Both lungs in their entirety ...	1

The pulmonary tissue changes in lobar pneumonia occur in four stages: (1) congestion; (2) red hepatization; (3) gray hepatization; (4) resolution. Frequently two or more stages are met with simultaneously in different areas of the same lung:—

1. *Stage of Congestion.*—The involved tissue is markedly hyperemic, dark red in color, and denser and less crepitant than normal, though the alveoli still contain some air. The lumen of the air-vesicles is encroached upon both by surrounding engorged capillaries, swollen alveolar epithelium, and an exudate, still fluid, containing red blood-cells, a few leucocytes, and desquamated epithelium. The usual duration of this stage is twenty-four hours, but it may continue for several days.

2. *Stage of Red Hepatization.*—The lung-tissue is brownish red in color, though less congested than in the first stage, and shows a distinct increase in size, weight, and consistency. Upon the surface, indentations produced by the ribs are often observable. The tissue sinks in water and resembles hepatic tissue, whence the term “hepatization.” The lung is very friable and the cut surface is dry, dull, and granular, the exudate having increased in amount until it filled the alveoli and then coagulated to a solid mass. The

exudate contains mononuclear and polynuclear leucocytes, erythrocytes, desquamated epithelium, and pneumococci. Minute casts of clotted exudate can be drawn from the small bronchi by scraping the cut surface with a knife.

3. *Stage of Gray Hepatization.*—Gray hepatization gradually develops from the preceding stage, and is the result of increased exudation of leucocytes as well as diminution of hyperemia owing to pressure by the exudate on the blood-vessels. The lung becomes grayish red, then gray, in color, and is less granular and more moist and brittle than before, owing to liquefaction of the alveolar contents through degenerative changes in the desquamated epithelium, dissolution of the red blood-cells, and transudation of serum from the vessels. Polynuclear leucocytes now constitute a large part of the exudate, which becomes more puriform in appearance. The exudate becomes more and more soft, in consequence of autolysis and disintegration of the fibrinous network, and its color disappears, owing to removal or decomposition of the coloring matter of the erythrocytes. At least one-half the fatal cases succumb in the earlier part of the stage of gray hepatization.

4. *Stage of Resolution.*—The softened exudate is removed in large part by absorption, to a less extent by expectoration. Air progressively re-enters the alveoli, and regeneration of the lost alveolar epithelium takes place from that which had escaped the processes of desquamation and degeneration. Resolution usually begins with the crisis, though sometimes later.

Where resolution fails to occur, the condition resulting may be one of dif-

fuse purulent infiltration; or, one or more abscesses may form, owing to secondary infection with pyogenic organisms. A portion of a lobe, or an entire lobe, may become gangrenous, owing to obstruction of blood-supply and putrefactive secondary infection. In a few instances pneumonia terminates in induration (chronic interstitial pneumonitis), more frequently, in tuberculosis,—the latter especially where the apex has been involved. Delayed resolution does not prevent an eventual complete return to normal.

Associated pathological conditions in pneumonia include usually some hyperemia and edema of the unsolidified lung-tissue, sometimes bronchitis, and nearly always fibrinous exudation on the adjacent pleural surface. The peribronchial and tracheal lymph-nodes are often enlarged and softened. The spleen is swollen, and the myocardium, liver, and kidneys may show parenchymatous or even fatty changes. A catarrhal state of the gastrointestinal mucosa is frequently noted *post mortem*. The heart, especially on the right side, is often greatly dilated, and may contain firm blood-clots,—due to an increased amount of fibrin in the blood,—which may have been the cause of death.

In lung infection by Friedländer's pneumobacillus, distinct disease foci may be produced in a single pulmonary lobe. Abundant mucus formation, especially in the earlier stages, imparting a slippery feeling to the finger, is a feature. The proportion of fibrin and erythrocytes to the leucocytes and desquamated epithelium in the exudate is said to be less than in pneumococcic pneumonia.

Report of 3 fatal cases of pneumonia associated with jaundice in

which the bile at autopsy showed pure cultures of pneumococcus. Lemierre and Abrami (*La Presse méd.*, No. 10, p. 82, 1910).

Proteolytic ferments were found by the author to develop in the blood during pneumonia about the time of crisis. These ferments seem to have special action on pneumococcus protein and may take part in the mechanism of the crisis. Dick (*Jour. of Infect. Dis.*, May, 1912).

The crisis in lobar pneumonia probably occurs when the toxic substances of the pneumococci have been digested beyond the toxic stage. The factors which seem to be concerned in this process are the autolytic ferment of the pneumococcus, the increased proteolytic power of the serum, the proteolytic action of the leucocytes, and the increased opsonic power of the serum, with consequent greater phagocytosis. Rosenow (*Jour. of Infect. Dis.*, July, 1912).

COMPLICATIONS AND SEQUELS.—*Pleuritis.*—Acute fibrinous pleuritis is a constant accompaniment of pneumonia where the morbid process reaches the visceral pleura. In some cases, however, liquid exudation takes place (metapneumonic pleuritis). The serous fluid exuding is peculiar in that it often contains much more fibrin than that produced in ordinary pleurisy. The signs of effusion may be obscure in the presence of lung consolidation. On the other hand, the true pneumonic symptoms may be obscured by the intensity of the accompanying pleuritis (pleuropneumonia). In some instances (1 per cent. of all cases), especially in children, a purulent exudate is formed (metapneumonic empyema). Pleural complications should be thought of where there is delayed convalescence, with chills, fever, sweats, a sudden rise in the leucocytosis, flatness on percussion, greatly augmented resistance to the percussing

finger, and absence of breath sounds and of râles. A paroxysmal cough brought on by movements and often unaccompanied by expectoration may also be noted. Because of the resistance offered by the solidified lung to the accumulating fluid, a relatively slight effusion may cause serious displacement of other viscera, in particular the heart. The importance of recognizing a pleural effusion is therefore manifest, as aspiration may become necessary to relieve circulatory embarrassment. The exploring needle should, in fact, be used without hesitation where the symptoms and signs do not permit of a positive diagnosis. Whether the effusion be serous or purulent, the pneumococcus can usually be discovered in it.

Pericarditis.—This complication has been noted as occurring in 5 per cent. of a series of cases, and is met with oftenest in young adults. Though it is commonly of the fibrinous variety, there may be a considerable serous exudate, and occasionally a purulent exudate. Augmented dyspnea and an increase in the pulse rate should bring to mind the possibility of this complication, the advent of which is, however, often very insidious. Precordial pain may or may not be produced. The diagnosis is dependent upon the physical signs.

Among 300 necropsies on pneumonia patients, pericarditis occurred in 72 instances, or 24 per cent. Forty-four of these patients had developed acute purulent pericarditis, 14 had developed acute sero-fibrinous pericarditis, while 14 had developed the subacute form of fibrinoplastic or purulent pericarditis manifested by the so-called "shaggy heart," or *cor villosum*. Hydropericardium existed in 12 instances. W. T. Stone (*Trans. Amer. Med. Assoc.*, June 12, 1919),

Endocarditis.—Acute endocarditis occurs more frequently than pericarditis, and may be simple or malignant, more frequently the latter. Any valve may be involved, but the condition is commonest at the aortic valve, and particularly attacks subjects of chronic valvular disease. Septic manifestations and evidences of embolism constitute the chief factors in the diagnosis, symptoms being generally and murmurs frequently absent. The supervention of meningitis upon endocarditis confirms the diagnosis of the latter.

Meningitis.—Acute meningitis is an occasional complication of pneumonia. Violent and persistent headache, neck rigidity, and delirium followed by stupor and coma indicate a probable meningitis, but often the symptoms are not so marked and distinction from mere "meningism" can be made only by lumbar puncture. In actual meningitis the inflammation of the meninges is fibropurulent, and death usually follows. Pneumococci may be found upon lumbar puncture in these cases.

Cerebral complications in pneumonia may be divided into 2 classes: (1) those caused by gross lesions, such as pneumococcic meningitis, thrombosis, embolism, abscess, etc.; (2) hemiplegias, generally in young and rather vigorous persons, with prognosis better than in the first group. There are 4 principal explanations of the hemiplegias of this group: (1) encephalitis of the Strümpell type; (2) hysteria; (3) circulating organisms; (4) circulating toxins. It is probable that more than one theory is correct. Pneumonic hemiplegia without gross lesion usually appears about the second or third day from the onset of pneumonia. It may be complete, but oftener is limited to the face, tongue, and right upper extremity. There may be aphasia, usually of ataxic type. Diagnosis is

sometimes difficult, especially of meningitis, and lumbar puncture should always be practised. In proportion as the organic group of hemiplegias is excluded, prognosis is favorable. C. F. Withington (Amer. Jour. Med. Sci., Feb., 1914).

Nephritis.—Acute nephritis occurred, according to Norris, in 1.3 per cent. of a series of 20,107 cases of pneumonia. Albuminuria and casts in the urine form the basis of the diagnosis.

Other, less frequent, complications of pneumonia include general bronchitis, parotitis, otitis media, synovitis, and arthritis, toxic myocardial degeneration, heart-clots, gastritis, duodenitis (causing jaundice), enteritis, colitis, phlebitis, peritonitis, and peripheral neuritis. In a series of 18 cases of complicating parotitis, both glands were successively involved in 4 instances, and incision and evacuation of pus were required in 5 cases.

Pleurisy is the commonest complication of pneumonia. The next most frequent and always serious complications are those connected with the heart and vasomotor apparatus. Of 12,383 cases of pneumonia reported by Preble, pericarditis occurred in but 0.77 per cent.; Wells, in 6000 cases found but 19 complicated with endocarditis, or 0.3 per cent.; Norris, in a series of 500 cases, reported 5 complicated with endocarditis; so that it may be safely stated that endocarditis does not occur as a complication of pneumonia in more than 1 per cent. Pericarditis is of more frequent occurrence. The average mortality of cases with endocardial conditions is given as from 90 to 95 per cent., while the pericardial cases show a mortality of 15 per cent.

Nephritis, in Preble's series of 13,591 cases, occurred in 178 cases, or a little over 1½ per cent. In 424 autopsies reported by Kerr there were 8 cases of abscess of the lung,

or about 2 per cent. of the cases going to autopsy. Abscess rarely occurs in the cases ending by crisis. Gangrene of the lungs follows less often than does abscess.

The mortality in cases in which tympanites is marked is about 50 per cent. Postfebrile delirium, while not peculiar to pneumonia, occurs as a sequel more often than in any other disease. The author has seen 4 cases, 3 of them maniacal. The condition is probably due to extreme debility, as it generally promptly improves under active stimulation P. H. Markley (Jour. Med. Soc. of N. J., Aug., 1913).

Sequels.—Relapse occurs in some cases of pneumonia, the temperature rising again a few days after the crisis and remaining febrile for two days to a week. As already mentioned, recurrences after more or less prolonged intervals are frequently met with.

Where resolution is delayed for many days or several weeks, fibroid induration of the lung-tissue is a likely sequel, sometimes resulting in marked retraction of the chest wall. Purulent infiltration, another possible sequel of pneumonia, shows itself by the expectoration of large amounts of purulent material containing pulmonary elastic tissue, together with the signs of a cavity as the abscess increases in size. Gangrene of the lung reveals itself by the markedly offensive odor of the sputum, the presence of elastic tissue, and by constitutional symptoms of infection.

PROGNOSIS.—The mortality rate of lobar pneumonia is from 15 to 40 or more per cent., the average being 18 to 25 per cent. The rate varies greatly under the influence of different factors and associated conditions, such as the severity of the infection, age, race, previous condition of health, complications, etc. Children

generally recover; after the twentieth year the death rate increases gradually until old age, when the disease becomes most dangerous, with a mortality of 50 to 80 per cent. The mortality is greater in the negro than in the white race. In individuals already weakened by disease or insufficient food, pneumonia is distinctly more fatal than in the previously healthy. In alcoholic subjects death very commonly occurs. Obesity also exerts an unfavorable influence.

As regards severity of the infection in the individual case, the chief factors bearing upon prognosis are: the range of the temperature, the condition of the circulation, the intensity of toxemia, and the degree of leucocytosis. A temperature persistently as high as 105° F. is of grave prognostic import. Increasing pulse rate after the fifth day signifies cardiac enfeeblement, and lessened intensity of the pulmonary second sound, insufficiency of the right ventricle. Marked toxemia is indirectly an unfavorable prognostic factor, impairing cardiac action. Absence of leucocytosis is a bad sign, except in the very mildest cases. Delirium, if pronounced, and especially if present early in the disease, is also unfavorable. The prognosis is graver when a large amount of lung-tissue is involved, *e.g.*, in double pneumonia. Pneumonia at the apex is more serious than at the base. The prognosis is better in cases of pneumococcic causation than in those attended with streptococcic or mixed infection. According to Fenwick, the intensity of albuminuria is of considerable prognostic value; cases beginning with a severe gastrointestinal attack are twice as likely to end fatally as

those exhibiting the more usual initial chill.

Any complication renders the prognosis graver. Endocarditis—usually ulcerative—and to a much less extent pericarditis, are considerably feared as complications. Pulmonary emphysema, extensive bronchitis, abscess or gangrene of the lung, and hyperemia and edema of the uninvolved portions of pulmonary tissue, are to be looked upon with serious apprehension. Pleuritis associated with considerable effusion, or attacking the uninvolved side, is an unfavorable prognostic manifestation. Acute meningitis as a complication renders the prognosis absolutely bad.

Death in uncomplicated cases occurs frequently from insufficiency of the right ventricle, due to the increased effort demanded as a result of pulmonary consolidation, coupled with the action of the toxemia on the myocardium. Vasomotor paresis is also often a lethal condition. Death from insufficiency of respiratory function of the lungs is very infrequent. Severe toxemia, manifested not only in heart weakness, but also in the typhoid state, severe diarrhea, and tympanites, may be the cause of death; likewise, pneumococcic infection of structures such as the endocardium, pericardium, and meninges.

TREATMENT.—The pneumonic patient should be isolated in a well-ventilated room, or better, placed wholly or partially out of doors, as on a sleeping porch or in an improvised window tent. The beneficial influence of an abundance of **fresh air** on the toxemia, febrile symptoms, anorexia, cough, and delirium of pneumonia has been definitely proved. Where out-of-door treatment is not

practicable, the windows of the sick-room should be kept wide open. The temperature of the room should be about 60° to 65° F. (15.6° to 18.3° C.) unless the patient be young or very old and feeble, when a slightly higher temperature may be advisable. An excess of covering bedclothes should be avoided, in order not to hamper the already overtaxed respiratory system by placing an obstacle to the chest movements. In open-air treatment sufficient covering should, of course, be provided to make the patient comfortable, and the head should be covered.

Observations on the blood-pressure of infants and children ill with pneumonia. Cold, fresh air always produces a rise in blood-pressure and removal to a warm, well-ventilated ward produces a fall. The rise is not apparent until half an hour or more, and does not reach its maximum for about two hours. The effect is continuous as long as thirty hours; there is no tendency of the pressure to fall as if from exhaustion. On removing the patient to warm, fresh air the fall is apparent in from fifteen to twenty minutes and reaches its lowest point in one hour. In convalescent patients the results are much less striking. The usual rise due to cold air is from 10 to 15 mm. of mercury. The favorable effect could not be produced when the children were simply put outdoors in warm weather; therefore, it would seem that the cold was the important factor. The effect on the blood-pressure is evidently produced through reflex stimulation of the vasomotor center by the action of cold air upon the skin of the face and on the nasal mucous membrane. J. Howland and B. R. Hoobler (*Amer. Jour. of Dis. of Children*, May, 1912).

The patient should, in general, be allowed to assume in bed that position in which he breathes most easily; the tendency to hypostatic conges-

tion should, however, if possible be antagonized. A careful physical examination of the entire chest should be made on the first three days, but after the affected pulmonary segment has been satisfactorily identified, the patient had best not be raised to the sitting posture for posterior examination; the phonendoscope should preferably be slipped under the patient for this purpose. The patient should not be permitted to rise from bed until at least one week after the crisis.

Rest is the chief desideratum in the treatment of pneumonia. **Morphine** should be given at once to insure quiet and rest. Measures to promote the circulation, especially to restore fluids to the body and render the blood less concentrated, should be taken: 10 Gm. (150 grains) of **salt** should be given to restore the proper balance of the fluids in the body. It may be given in thin broths into which an egg has been stirred, or in milk. After the salt is taken the patients are thirsty and call frequently for water. The **diet** is restricted to fluid food given every hour during the fever, the patient being awakened when necessary. The individual does not lose weight so rapidly and recovers more quickly. Wyss (*Zeit. f. klin. Med.*, Bd. lxx, No. 2, 1910).

The bedclothes should be kept unwrinkled and the comfort of the patient promoted by **sponging with warm water** morning and evening, without uncovering him. Warmth of the limbs should be maintained with **hot-water bottles** or other similar means. Where sweating is pronounced, **lotion with warm alcohol**, followed by **rubbing with a coarse towel**, may be practised. To assist in preventing skin irritation, talcum powder may advantageously be used

in cutaneous folds and over surfaces exposed to friction.

An **antiseptic mouth-wash** should be ordered in pneumonia. Thorough **disinfection of the sputum** is an important measure from the prophylactic standpoint. The sputum should always be collected in suitable receptacles and either burned, treated with lysol or some similar solution, or subjected to disinfection by Finkler's method. The latter consists in adding the sputum to a solution of 3 per cent. each of borax and potassium hydrate, colored with phenolphthalein, allowing the sputum to dissolve, and adding further a solution of mercury bichloride and hydrochloric acid in sufficient amount to decolorize the mixture.

Diet.—The diet in pneumonia should be nutritious but easily digested, and, in the early stages at least, chiefly liquid. Milk naturally forms an important element in the diet, though it cannot be depended upon alone to supply the calories necessary for the patient's maintenance. Such substances as barley, oatmeal, cream, and cane-sugar or milk-sugar may be added to it to increase its nutritive properties. Where raw milk is poorly borne owing to the formation of large, irritating curds, $\frac{1}{2}$ teaspoonful of dilute hydrochloric acid in 1 pint of water may be slowly added to a quart of milk, and the mixture heated to boiling with constant stirring and given to the patient in divided amounts (Elsner). The milk may also be diluted with lime-water or Vichy, or given predigested.

Meat or vegetable soups or broths rendered thicker by the addition of a small amount of flour or powdered

rice, together with white of egg or whole egg, may also be administered with advantage. Among other articles which may be well borne are cornstarch, arrowroot, strained oatmeal gruel, gelatin flavored with wine, junket, calf's foot jelly, ice-cream, water ice, grapefruit, buttermilk, kumyss, etc. All food should be given in small quantities at short, definite intervals, to avoid distention of the stomach and interference with heart action at any given period. After the crisis, vegetable purées, milk-toast, soft-boiled eggs, omelet, scraped meat, stewed or ripe fresh fruits, and, soon afterward, chicken, sweetbreads, etc., may be employed. Overtaxing of the digestive organs, however, is at all times to be avoided.

Water should be quite abundantly supplied throughout the course of the disease. Orange-juice, with or without whipped albumin, also lemonade and similar preparations may be administered. Pneumonia patients exhibit quite a high degree of tolerance for alcohol, which may not only serve as a rapidly assimilated generator of heat and a stimulant, but may increase the appetite and facilitate the digestion of food where this is imperfect. Where these indications obtain, alcoholic preparations such as whisky, brandy, champagne, and white wine may be given, preferably in small, repeated amounts. In alcoholic patients its administration is even more definitely indicated, lest collapse occur through discontinuance of an accustomed stimulant.

It is a mistake to give the patient a heavy **diet** during the first three or four days of illness. It should be very gradually increased as the patient seems capable of digesting it. A good combination consists of an

infusion of $\frac{1}{2}$ pound of raisins in a quart of hot water with 3 or 4 ounces of syrup of glucose, 2 drams (8 Gm.) of the **glycerophosphate** or **lactate of calcium**. The patient can drink this *ad libitum*. Milk is not always easily digested, and should be well diluted as well as boiled to get rid of the *B. coli* and other organisms. The following is cited to serve an adult in the acute stage for twenty-four hours: About 2 pints of milk, 2 or 3 pints of barley-water, whey, or plain water, 6 or 8 ounces of syrup of glucose, 4 or 5 drams of table salt, and 1 dram of the glycerophosphate of calcium. If the syrup of glucose be too sweet or mawkish, a quarter of a pound of sugar of milk can be used. Later on the patient can have peptonized bread and milk or some infants' food, broths, raw eggs, jellies, cocoa or coffee, and a few biscuits. J. Barr (Brit. Med. Jour., Jan. 10, 1914).

The purpose of the **diet** recommended by the author is to supply nourishment sufficient to carry the patient through the disease with a minimum of trouble for the alimentary tract. The diet during the febrile period and for three days after deferescence is as follows:—

8 A.M.: Give 7.5 ounces (225 c.c.) of a 2 to 1 mixture of milk and barley-water to which has been added 5 grains (0.3 Gm.) of **sodium chloride**. 8.30 A.M.: 10 grains (0.65 Gm.) of **calcium chloride** dissolved in 5 ounces (150 c.c.) of water. 10 A.M.: 7.5 ounces of milk and barley-water mixture. 11 A.M.: 7.5 ounces of orangeade made with the strained juice of one orange and 1 ounce (30 c.c.) of milk-sugar. 12 M.: 7.5 ounces of milk and barley-water. 12.30 P.M.: 10 grains of calcium chloride in water. 2 P.M.: 7.5 ounces of milk and barley-water. 3 P.M.: 7.5 ounces of orangeade. 4 P.M.: 7.5 ounces of milk and barley-water. 4.30 P.M.: 10 grains of calcium chloride in water. 6 P.M. and 8 P.M.: 7.5 ounces of milk and barley-water. 8.30 P.M.: 10 grains of calcium chloride in water. 11.45 P.M.: 7.5 ounces of orangeade. 11.55 P.M.: 10

grains of calcium chloride in water. Administer everything through a tube without raising the patient's head.

This prescription supplies about 38 Gm. ($1\frac{1}{4}$ ounces) of protein and fuel to the value of 1200 calories.

On the fourth day after defervescence in uncomplicated cases, the diet is modified by substitution of cooked wheat cereal, 6 ounces (180 c.c.) with milk, 3 ounces (90 c.c.); boiled rice, 6 ounces (180 c.c.), with milk, 3 ounces (90 c.c.), and milk toast, two slices, with milk, 3 ounces, for 3 of the milk and barley-water feedings, respectively, and omission of the calcium chloride. On the seventh day after defervescence, or as soon as convalescence is assured, further additions are made.

In the series of 54 cases thus treated, there were but 4 deaths, of which 2 occurred in patients moribund when first seen. Pronounced vasomotor paralysis or tympanites in noticeable degree was not observed in any case. E. E. Cornwall (N. Y. Med. Jour., May 30, 1914).

Medicinal and Symptomatic Treatment.—The chief indications in the average case of pneumonia are to minimize toxemia and forestall serious enfeeblement of heart action. Various symptoms, however, may also demand special attention, as explained in the subjoined paragraphs.

Toxemia.—Elimination is the chief agency now at our command in overcoming toxemia. **Calomel** in an initial large dose of 10 grains (0.6 Gm.) or in fractional doses, followed by a **saline purgative**, is an important measure in the early, sthenic stage of the disease, serving both to empty the intestine and lower blood-pressure. Subsequently the bowels should be kept active, to prevent absorption of any toxic material formed through fermentative processes.

Diuresis should in all cases be

maintained and enhanced by the administration of **water in large amounts**, *e.g.*, 6 pints (3 liters) per diem in an adult. **Lemon-, lime-, or other fruit-juice**, or such drugs as **potassium bicarbonate, citrate, and acetate**, may be added to it. Progressively increasing toxemia, with impairment of renal function, urgently indicates repeated **hot saline enteroclysis, hypodermoclysis, or intravenous infusion**. Sajous, calling attention to the large consumption of the body chlorides in pneumonia, and pointing to the necessity of a normal supply of salts in the blood to maintain its osmotic properties and protective efficiency, strongly urges the oral use of a **saline beverage** throughout the disease made up as follows: *Sodium chloride*, 10 grains (0.6 Gm.); *potassium bicarbonate*, 5 grains (0.3 Gm.); *water*, 8 ounces (240 c.c.). Addition of a teaspoonful of lemon-juice to the above transforms it into an effervescent beverage, which can be offered to and is gratefully taken *in toto* by the patient every two hours. The potassium bicarbonate antagonizes acidosis. Excellent results have been obtained with this procedure by Todd, J. M. Taylor, and others.

The property of **sodium citrate** of preventing coagulation and reducing viscosity of the blood makes it doubly valuable in the treatment of pneumonia. The writer gives sodium citrate, with plenty of water, in doses of from 15 to 20 grains (1 to 1.3 Gm.) each hour, or 40 grains (2.6 Gm.) every 2 hours, sometimes more, to a full-sized adult, and continued night and day until the result is attained. Occasionally, this dose acts as a purge. This should be checked by a few doses of an opiate. Weaver (N. Y. Med. Jour., Nov. 1, 1919).

Study of the fluidity of the blood with the viscosimeter on pneumonia cases appears to justify the **citrate** treatment. The blood viscosity has almost invariably been found high in pneumonia, especially in comparison with the hemoglobin values. L. Cheinisse (*Presse méd.*, Feb. 14, 1920).

Elimination through the skin should be maintained by **sponging** the patient two or three times daily with **tepid water**.

In the early stage of pneumonia, *in children*, counterirritation may be of value, the best form being the home-made **mustard paste**. When cyanosis is marked and respiration shallow, nothing aids respiration and clears up cyanosis so well as a **cold chest compress**. If the fever is giving trouble and simple sponging is not adequate, the best way to secure positive action is by the **cold pack**. At the beginning of an attack, in addition to a **cathartic**, a refrigerant, such as **potassium citrate**, in dose of 1 grain (0.065 Gm.) to each year of the child's age up to 4, or **liquor ammoniæ acetatis**, 15 drops at 1 year up to 1 dram (4 Gm.) at 4, with **tincture of aconite** from $\frac{1}{4}$ drop at 6 months to 1 drop at 3 or 4 years, greatly adds to the child's comfort and has some value in reduction of fever. This should usually be kept up for 1 or 2 days. If there is threatened heart-failure, particularly at the crisis, the best drug is usually **strophanthus**, given in the tincture, 1 drop for a child of from 6 months to 1 year, 2 drops for a child from 3 to 5 years. **Strychnin** is occasionally called for in a heart weak and irregular and not very fast. For right heart-failure **nitroglycerin** is indicated. Alcohol, if needed at all, must be used in good-sized doses, in the form of whisky or brandy. Ludlum (*L. I. Med. Jour.*, Oct., 1910).

Following **mercury** and **sulphur** combination advised in both *lobar and lobular pneumonia*: *Hydrargyri chloridi corrosivi*, gr. ss (0.03 Gm.); *sulphuris præcipitati*, ʒij (8 Gm.); *aquæ destillatæ bullientis*, fʒiv (120 Gm.). This is to

be shaken and then quickly given in the dose of 1 teaspoonful every two or three hours for two or three days. If, when the thirty-second dose is reached, catharsis has not occurred, $\frac{1}{2}$ ounce (15 c.c.) of **castor oil** is given. Cessation of fever and loosening of cough promptly follow these measures; lung infection is apparently cut short. Kolipinski (*Monthly Cyclo. and Med. Bull.*, July, 1913).

Lobar pneumonia, as it occurs *in children*, is generally a disease with a very favorable prognosis. Nearly all the cases of what has appeared to be fatal croupous pneumonia in children are probably instances of bronchopneumonia of the pseudolobar type.

The author applies **hydrotherapy**, oftenest in the form of warm tub baths, if the high temperature is attended by nervous symptoms. If these are not present, the temperature apparently does little damage. **Digitalis**, **caffeine** and the like are used should the occasion require, but the author depends more upon **alcohol** than any other drug of this class. Cough requires a sedative only if very annoying; opiates are then used, provided there is no marked tympanites. Counterirritation of any kind is unnecessary unless the case happens to be complicated by severe bronchitis. J. P. Crozer Griffith (*Med. Times*, Jan., 1914).

Cleaning out the gastrointestinal tract by an initial intestinal sweeping with **castor oil**, repeating this every second day through the disease, is one of the best measures for securing a favorable prognosis in either type of pneumonia. Other purgatives may be used, but it is well to avoid any that irritate the kidneys. Perhaps **magnesium citrate** is second best.

In febrile fibrinous pneumonia, **sponging** at regular intervals for high temperature, with **hot or cold water** is useful; the **hot sponge** is far more restful and stimulating to the heart. The writer's favorite method of counterirritation is to **dry cup** the chest over involved portions of the lung, and then apply over the entire chest

hot stupes prepared by sprinkling **turpentine** directly on steaming moist flannel. **Atropine**, given hypodermically, is the most useful drug, both as cardiac tonic and respiratory stimulant. R. N. Wilson (Jour. Amer. Med. Assoc., Jan. 24, 1914).

Fever in pneumonia does not, as a rule, require active treatment. Cases with high fever (104° F.— 40° C.) in the earlier stages of the disease frequently do better than those in which only a gradual rise in temperature takes place. Where, however, the temperature remains persistently above the level mentioned, corrective measures are required. In the very young, the very old, and where there is cardiac weakness, **sponging the limbs in succession with hot water**, under the covers, together with the application of **cold to the head**, is as safe as well as effective procedure. In other cases **cloths wrung out of ice-water** may be applied to the chest for two hours, with renewal every fifteen minutes; these applications may be repeated after intervals of two to six hours. Good results follow this procedure, not only in lowering of temperature, but also in alleviation of nervousness, dyspnea, and cyanosis. The reaction of the patient as well as the return of higher temperature should be considered in ordering repetition of the cold applications. **Ice-bags**, preferably those provided with a drainage-tube, or the **Leiter coil**, may be substituted for the cold cloths. Application of cold over the area of pulmonary solidification should be provided for in each instance. When the temperature has been reduced to a safe level, removal of the refrigerant agent is generally advisable, unless pain coexists. **Cool or cold sponging** is frequently a use-

ful measure. **Cold baths**, administered as in typhoid fever, have not given as good results as in the latter affection, and are now considered indicated only where hyperpyrexia and a good condition of the circulation exists or where other procedures fail. **Hot baths** have been recommended by Ortner, Lemoine, and others. In the average case Elsner has had satisfactory results from **cold sponging combined with the use of cold compresses or ice-bags to the chest**.

Use of **ice-bags**, applied so as to include between them the inflamed area of lung, recommended in the early stage of the disease. Precautions required: (1) If dullness corresponding to right auricle in fourth right interspace exceeds $1\frac{1}{2}$ finger-breadths, and if dullness be also detectable in third space close to sternum, right heart should preferably be relieved with **leeches** before ice-bags applied. (2) **Keep lower extremities warm with woolen stockings and hot-water bottles**. (3) Use thermometer frequently, especially in children. (4) **Inhalations of oxygen** passed through absolute alcohol, and the addition of **malted milk powder to milk** in order to increase its nutritive value, are also recommended. D. B. Lees (Lancet, Feb. 25, 1911).

Hot baths recommended in the treatment of pneumonia in adults. The whole body, except the head, is immersed in water at 40° or even 42° C. for about ten minutes, twice daily. A **towel previously dipped in cold water is placed over the head during the bath** and renewed whenever it becomes warm. After the bath the patient is quickly dried off, wrapped in a blanket, and carried back to bed. From one-half to one hour later, a flannel shirt is donned, which is worn until the next bath is given. Upon removal from the water, the sensation of heat persists for an hour at least, and is accompanied by free sweating. The results are excellent. The gen-

eral condition rapidly improves, especially in adynamic cases; sleep is favored in delirious patients, the output of urine increases, and the tongue remains moist. The temperature after 3, 4, or 5 baths suddenly drops, coincident with improvement in the condition of the lungs. Dyspnea is much diminished, expectoration is free, and on auscultation bronchial breathing is observed rapidly to decrease and disappear. Crepitant râles reappear more promptly than in pneumonia treated by other methods. The drop in the temperature always takes place by the end of the third day at latest. Lemoine (*Quinzaine therap.*, May 25, 1912).

The use of antipyretic drugs such as antipyrin and acetphenetidin in pneumonia is to be avoided, not only because of their tendency to depress the heart, but because of the possibility of impairment of the hemoglobin (rather with acetanilide and acetphenetidin than antipyrin) and consequent increase of cyanosis.

The urine of a pneumonia patient shows almost constantly absence of sodium chloride. Administration of **potassium nitrate** in full doses causes the sodium chloride to reappear in the urine within a few hours and to continue present as long as the potassium nitrate is given. The effect upon the course of the disease is remarkable. The temperature almost invariably begins to fall within a few hours and continues to drop until it reaches normal. The physical signs remain for a few days, and then resolution begins and goes on to recovery without crisis. The writer has given 60 grains (4 Gm.) of potassium nitrate solution every three hours for the first day, decreasing the dose somewhat each day, without the slightest disturbance of the stomach. The diet should be as nearly salt-free as possible. To increase the circulation through the hepatized lung-tissue and promote the release of sodium chloride from the exudate, the author

gives **nitroglycerin**, $\frac{1}{100}$ to $\frac{1}{50}$ grain (0.00065 to 0.0013 Gm.) every three hours. H. G. Hughes (*N. Y. Med. Jour.*, Sept. 9, 1911).

Sodium citrate internally was found in most cases of lobular pneumonia, especially in children, to cause a fall in temperature, pulse, and respiration to normal within twenty-four hours; the process in lung clears up soon after, the third stage being apparently escaped. It was administered in doses of 30 to 40 grains (2 to 2.6 Gm.) in adults every two hours, with a little **citric acid** or in **lemonade**. The dose for children should be calculated from a 40-grain dose in adults. The drug is to be continued till the clearing up of the process in the lung is complete. Active **catharsis** should be established at beginning of treatment. **Sodium chloride** should be supplied to system in about the normal daily amount (240 grains, or 16 Gm.), with the diet or otherwise. W. H. Weaver (*N. O. Med. and Surg. Jour.*, Sept., 1912).

Application to the chest of a mixture of 10 Gm. ($2\frac{1}{2}$ drams) of **salicylic acid** in 90 per cent. alcohol with 10 Gm. ($2\frac{1}{2}$ drams) of **castor oil** recommended in pneumonia. The skin is first washed with ether and then 1 or 2 spoonfuls of the solution are applied on a gauze and the whole covered with cotton and rubber tissue, held in place with a bandage. The dressing is renewed three or four times a day. The writer supplements the salicylic always with heart tonics, enemata, and an alkali internally to prevent irritation of the kidneys as the drug is eliminated through them. Defervescence never fails to occur on the third day. P. B. Aquino (*Semana Medica*, Buenos Aires, Dec. 26, 1912).

Use of Harrower's acidimeter found valuable in pneumonia. In cases with a temperature running from $104\frac{1}{2}^{\circ}$ to 105° F. (40.3° to 40.5° C.) at the outset, the acidity of the urine ranges from 90 to 100 degrees. The normal acidity is between 30 and 40 degrees. With an

alkaline and eliminative treatment, as soon as the urine becomes alkaline, the temperature dropped to 102° F. (38.9° C.), the patient was very much more comfortable and progressed to rapid recovery. G. E. Titus (Jour. Med. Soc. of N. J., Aug., 1913).

Chill.—Treatment of the initial chill, when the patient is seen at this stage, consists in the use of a **hot mustard foot-bath** (given with the patient in recumbency), the external application of **heat** by means of **hot-water bags**, and the **ingestion** of a cupful of **hot water** to which $\frac{1}{2}$ fluidram (2 c.c.) of **aromatic spirits of ammonia** has been added.

Pain.—For the initial pain in the side, if severe, a hypodermic injection of $\frac{1}{6}$ grain (0.01 Gm.) of **morphine** may be given. More frequently, however, the pain, not being of an agonizing character, will be subdued by the hypodermic administration of **codeine phosphate** in the dose of $\frac{1}{2}$ grain (0.03 Gm.). In relieving the pain these drugs will tend to enhance the circulation in the lungs, and will also lessen dyspnea and promote rest. Caution in their use is, however, demanded where the bronchi are already filled with secretions, as from associated bronchitis.

Other effectual measures for relieving the initial pain include the application of 20 or more **dry cups** on one or both sides of the chest; use of the **ice-bag** or of **Leiter's coil**; **strapping** the affected side, the plaster being overlapped and extended beyond the midline both anteriorly and posteriorly; light application of the **thermocautery**, and, as recommended by Elsner, the use of absorbent cotton impregnated with 2 fluidrams (8 c.c.) of **compound mustard liniment**, applied to the affected

side for fifteen to twenty minutes. **Deodorized tincture of opium** or **Dover's powder** may be substituted for morphine or codeine. The use of the cotton jacket is an obsolescent measure, probably more useful as a placebo than for any actual benefit conferred.

Where pleuritic pain shows a tendency to persist for twenty-four to forty-eight hours, **cupping** may be repeated two or three times. In children, small doses of **tincture of ipecacuanha** and **opium** may be used with advantage, and in adults the same preparation used in average doses, or small amounts of **morphine** given.

Cough.—Cough in the early stages of pneumonia will be controlled by the measures already recommended for pain. Later in the disease, where cough is annoying and expectoration scanty, agents such as **ammonium chloride**, **terebene**, and the preparations of **antimony** (in small doses) are sometimes of value. For cough and excessive expectoration during convalescence, **compound tincture of benzoin**, given in 20-drop doses on sugar with a small quantity of water three or four times a day, is recommended.

Circulatory Conditions.—During the stage of pulmonary congestion the blood-pressure may be abnormally high. Free **purgation** and **diaphoresis** will tend to overcome this, but in many instances the desirability of **venesection** will have to be considered. Indications for the latter measure are present chiefly in the robust individuals with a bounding pulse and high pressure, as well as in plethoric, flabby patients early exhibiting a tendency to failure of the

right side of the heart, as shown by dyspnea, cyanosis, dilatation of the cutaneous venules, and contracted pupils. The amount of blood to be removed ranges from 8 to 20 ounces (240 to 600 c.c.), the smaller amount being not infrequently sufficient. Where present, symptoms due to toxic action on the brain are likely to be relieved by the venesection. This measure is, however, inadvisable in the debilitated.

Substitutes for venesection include the use of **veratrum viride**, **aconite**, **nitrites**, and **bromides**. **Veratrum viride**, with or without **bromides**, is most directly indicated in cases of high blood-pressure with cardiac hypertrophy, though many American physicians have extended its use to all cases, with the idea of relieving pulmonary congestion through dilatation of the splanchnic vessels and consequent derivation of blood from the lungs into the abdomen.

Aconite, less safe than veratrum, had probably best be eschewed in pneumonia, in view of the marked danger attending excessive cardiac depression in this disease. In cases complicated by chronic nephritis and arteriosclerosis, with high blood-pressure on the first few days of the disease, **nitroglycerin** or **sodium nitrite** may be advantageously used to relieve the overtaxed heart. Reid has emphasized the benefits accruing, even in the average case of pneumonia, from the application of 2 or 3 **leeches** over the solidified lung-segment, to be allowed to drop off of themselves when gorged with blood, and followed by **warm fomentations** for thirty-five minutes and the administration of **morphine**.

In a series of 100 cases of croupous pneumonia treated with **veratrum viride**, there were 93 recoveries and 7 necessarily fatal cases suffering from chronic diseases and old age. The greatest benefit from veratrum is in the stage of engorgement with blood. It rapidly controls the inflammation, preventing extension and complications. In the latter stages it also prevents extension of the morbid process.

Nausea, vomiting, and hiccough are generally caused by an overdose, and are, as a rule, easily relieved by placing the patient on his back and discontinuing the drug for a few doses. The drug is contraindicated in valvular diseases, fatty degeneration of the heart, gastritis, and peritonitis.

The following methods of administration are convenient: *Tinct. veratri viridis* (Norwood's), f3j (4 c.c.); *Vini ipecacuanhæ vel Spts. ætheris nitrosi*, f3ij (8 c.c.). M. Sig.: Give every three or four hours in a little water, commencing with 10 drops and increasing by 1 or 2 drops at each dose. Or, *Tinct. veratri viridis* (Norwood's), *Syr. scillæ comp.*, of each f3ij (8 c.c.). M. Sig.: Give every three or four hours in a teaspoonful of syrup of Tolu, commencing with 10 drops and increasing by 1 or 2 drops at each dose. T. G. Stephens (Monthly Cyclopedia, April, 1911).

In place of aconite and veratrum viride, the author recommends the use of **mustard foot-baths**, to be given with the patient prone in bed and disturbed only sufficiently to raise the feet into the foot-tub or pail. **Nucleinate of sodium** in solution, used subcutaneously, though rather painful, apparently does good service in pneumonia. Twice in the writer's experience has an apparently hopeless case been returned by this drug to the hopeful list and finally recovered. Philip Marvel (Jour. Med. Soc. of N. J., Aug., 1913).

When the diplococcus of Weichselbaum is present in the sputum of pharyngitis or bronchitis in overwhelming number, with such symptoms as tenacious sputum, persistent

hacking cough, and severe pain, the writer gives 5-grain doses of **boric acid**, 6 times daily. Ochsner (Cited by Homeopathic Rec., Oct., 1917).

Of great import as regards the outcome of pneumonia cases is the circulatory depression not infrequently appearing at the height of the disease and due to the action of the toxins circulating in the blood on the heart muscle and vasomotor centers. As this depression often sets in with relative suddenness and may rapidly carry off the patient, its early detection not only by ordinary methods of cardiac and pulse examination, but by systemic use of the sphygmomanometer, is of marked importance. Blood-pressure readings should be taken several times each day, and from comparison with the rate and quality of the pulse, an estimate of the general state of the circulation made. According to Gibson's rule, circulatory stimulation should be begun whenever the systolic blood-pressure, expressed in millimeters of mercury, falls below the pulse rate per minute. Any pressure considerably below normal in pneumonia is considered ominous, especially if a sudden drop has taken place. From the strictly cardiac standpoint, an accelerated, feeble pulse, weakening of the first sound of the heart, and loss of the pre-existing accentuation of the second sound, are unfavorable signs. In the absence of a blood-pressure record, stimulation should be begun as soon as the slightest tendency to heart depression is noted. In the presence of conditions manifestly making unusual claims upon the heart, *e.g.*, abnormally full, hard pulse, excited heart action, strong precordial pulsation, and severe dysp-

nea, it is perhaps better, as advised by Ortner, to anticipate heart weakness than to await its occurrence. The drugs chiefly used are **digitalis**, **caffeine**, **strychnine**, **epinephrin**, **alcohol**, **camphor**, **strophanthus**, and the "diffusible" stimulants, in conjunction with **nitroglycerin**, **saline solution**, and **venesection**, according to indications.

Strychnine has proven serviceable under many circumstances, and may be given hypodermically, at first in moderate, then in large doses, *e.g.*, $\frac{1}{15}$ grain (0.004 Gm.), or in smaller amounts at short intervals. By an increasing number of practitioners, however, strychnine is being less highly regarded than formerly.

Digitalis tincture, 8 to 10 minims (0.5 to 0.6 c.c.), with **belladonna tincture**, 5 to 8 minims (0.3 to 0.5 c.c.) every three or four hours, is of marked value where the heart is giving way to increased pulmonary pressure in the later stages of the disease. Digitalis is especially indicated where the pulse is rapid, small, and at times arrhythmic, and is contraindicated where cardiac conductivity is impaired. The **infusion of digitalis** in doses of 2 fluidrams (8 c.c.) three or four times a day, or Merck's **digitalin**, in doses of $\frac{1}{6}$ grain (0.01 Gm.), may be substituted for the tincture. In cases coming under observation with the right heart already engorged, Elsner recommends frequently repeated large doses of digitalis as a life-saving measure.

A good drug combination both for a circulatory stimulant and for diuresis in pneumonia is the "**A B C diuretic**,"—**acetate**, **bicarbonate** and **citrate** of **potassium**, āā gr. xv (1 Gm.); infus. **digitalis**, q. s. ad ʒij (8 Gm.); one dose. Another is: **Potas-**

sium iodide, gr. v (0.3 Gm.); **fl. ext. digitalis**, ℥j (0.06 c.c.); **fl. ext. convallariæ**, ℥xx (1.25 c.c.); one dose every three hours. J. B. Huber (Merck's Archives, Nov., 1911).

It never has been proved that cold, fresh, or open air for pneumonia or other respiratory diseases is the correct measure. Excessive use of cold air has been a fad, and has gone into the hands of nurses, hospital managers, and the laity. If among medical men there is doubt concerning the cases in which this treatment may be used, certainly it is not safe in other hands. J. P. C. Griffith (Jour. Amer. Med. Assoc., Jan. 1, 1916).

The following treatment of 1020 cases of pneumonia gave a 1.3 per cent. mortality. **Absolute rest in bed** even in mild cases. **Wards kept warm** and patients protected from draughts. No control of fever by hydrotherapeutic measures. On entering, the patient was given **Dover's powder**, 2.5 to 5 grains, and **quinine**, 2.5 to 5 grains, repeated every 4 hours, often discontinued on account of nausea. On the appearance of signs of consolidation, **camphor**, 36 grains, **in sterile olive oil** was given **intramuscularly** every 8 hours in men and every 10 hours in women. In the severe types this dose was given as often as every 4 hours for 4 doses and then every 8 hours. Some patients received as much as 800 grains in 7 days. In the severer cases that did not respond to the camphor, a transfusion of **citrated blood** from convalescent patients was practised, or **normal horse serum** was given. Stine (Mo. State Med. Assoc. Jour., Jan., 1919).

Caffeine strengthens the circulatory muscle-tissue, causing some acceleration of heart action, and promotes diuresis. It may be given by hypodermic injection of **caffeine and sodium benzoate** in doses of 1½ to 5 grains (0.1 to 0.3 Gm.) every three to five hours, or in the form of **strong coffee** by rectum.

Saline enteroclysis or **hypodermoclysis** is more especially indicated where caffeine is systematically used, to make up for the fluid lost through diuresis.

Epinephrin (adrenalin) may be given in doses of 5 to 20 minims (0.3 to 1.2 c.c.) of the 1:1000 solution (diluted) every one to three hours by intramuscular injection or with saline solution administered under the skin. It acts powerfully in raising blood-pressure and relieving splanchnic congestion, and is of great value in carrying patients through a critical period of circulatory depression.

In cases with blood-pressure below 110 mm. Hg and other symptoms of vasomotor paresis present (pulse soft, cyanosis not prominent, extremities warm), **epinephrin** in 10-minim (0.6 c.c.) doses of 1:1000 solution should be given intramuscularly, even before signs of pulmonary edema appear. Brown (American Medicine, Nov., 1911).

When the pulse rate in lobar pneumonia equals or exceeds the blood-pressure in millimeters, 2 to 5 grains (0.13 to 0.3 Gm.) of **caffeine** should be given hypodermically every four or six hours. Where further evidences of vasomotor failure appear, 15 minims (0.9 c.c.) of 1:1000 **adrenalin** solution should be given in addition, intramuscularly, every 2 or 4 hours. Butler (L. I. Med. Jour., Aug., 1912).

Alcohol, though its use is advised by some from the beginning of cardiac depression, had probably better be reserved for critical periods. Its action as a peripheral vasodilator should always be borne in mind. It may be given in the form of **whisky** or **brandy**, ½ fluidounce (15 c.c.) every three hours, or as **champagne** or **Tokay wine**, ½ fluidounce (15 c.c.) every half-hour.

Camphor is given hypodermically in doses of 2 to 5 grains (0.13 to 0.3 Gm.) every one to three hours, dissolved in 5 parts by weight of sterile cottonseed or olive oil. Combined with **digitalis** or **caffeine**, camphor is now highly regarded as a cardiac stimulant in pneumonia.

Strophanthus may be substituted for digitalis. **Strophanthin**, in particular, has been used with success as a rapidly acting circulatory tonic when injected intravenously in doses of $\frac{1}{130}$ to $\frac{1}{65}$ grain (0.0005 to 0.001 Gm.). The latter method should, however, not be used after digitalis has already been thoroughly tried out, as dangerous cumulative effects may follow.

The so-called "diffusible stimulants" are of value to maintain heart action through a period of excessive strain, but must be administered at short intervals, *e.g.*, every fifteen minutes, if a sustained effect is required. Elsner orders the following combination for this purpose:—

℞ *Spiritus ætheris compositi*,
Spiritus ammoniæ aromatici,
Spiritus lavandulæ compositi,
Tincturæ valerianæ ℥ xv (1 c.c.).

M. Sig.: To be given every fifteen minutes.

Where, as is rarely the case, the stomach rebels, the first ingredient is replaced by whisky or the amounts of the ammonia and lavender preparations doubled.

Other available stimulants are: **atropine** administered hypodermically to raise the blood-pressure and to antagonize pulmonary edema when present, **cocaine**, and **ammonium carbonate**.

Administration of **calcium chloride** in 10-grain (0.6 Gm.) doses every four

hours advised, from outset until three days after defervescence. Patients given it seem to do better than others. E. E. Cornwall (Med. Times, Jan., 1913).

Nitroglycerin, essentially a vasodilator drug, is actually indicated only where the heart is overburdened through the resistance to blood-flow offered by narrowly contracted or sclerosed peripheral vessels. Where this condition does not exist, great caution should be exercised in its use.

Venesection may yield good results in the later stages of pneumonia when marked cardiac dilatation and cyanosis occur. It may be followed by subcutaneous or intravenous introduction of **normal saline solution** to which **epinephrin** has been added.

In order to avoid the terrible mishap of a threatening heart-clot, the writer advises **lemonade** as a refreshing drink, or **sodium citrate** in the milk, or an occasional dose of **aromatic spirits of ammonia**, with or without a few drops of **tincture of nuxvomica**. Beverley Robinson (Amer. Med., Apr., 1910).

Respiratory Conditions.—Insufficient respiratory ventilation, due to loss of function of a considerable portion of the pulmonary surface through consolidation, may be antagonized, when so marked as to give rise—in conjunction with poor circulation—to cyanosis, by hypodermic administration of **strychnine**, **atropine**, etc., which will excite the respiratory centers to greater activity and tide the patient through a critical interval. Of more direct value, however, is the **inhalation of oxygen**, previously passed from the tank through a wash-bottle, to remove irritating impurities. At first the gas may be inhaled directly from the tube; when cya-

nosis has manifestly diminished it may be permitted to pass into the air near the patient's nostrils. Slowing of the pulse and an increase in the amplitude of breathing are to be watched for, in conjunction with diminished cyanosis, in regulating the amount of oxygen to be administered. The fresh-air treatment of pneumonia, when it is practicable, renders the use of oxygen far less essential than in indoor treatment.

Hypodermic injections of oxygen have been highly recommended by French observers as giving results superior to those obtained on inhalation. This procedure is readily carried out by disinfecting the skin over the external aspect of the thighs with tincture of iodine, and passing under it through a sterile needle a current of oxygen filtered through sterile absorbent cotton. Large amounts of the gas can thus be slowly introduced without the least untoward result.

Nervous Conditions.—Sleeplessness in pneumonia may be met by **hydrotherapeutic measures** and by the administration of **Dover's powder**, small doses of **morphine**, or a **hot alcoholic drink** at night. For delirium, **chloral hydrate** in average doses may be given provided there is no especial circulatory depression at the time. In other instances, small doses of **codeine**, **morphine**, or **hyoscine** may be given. The last-named remedy should not be repeated if delirium continues or is augmented after the first dose. Not infrequently remedies given to improve the circulation, such as **strychnine** and **alcohol**, will reduce delirium and other nervous phenomena. An **ice-bag** to the head is useful. Where the symptoms so increase as to simulate men-

ingitis, **lumbar puncture** should be considered as a probable beneficial procedure.

Special Remedial Measures.—Quinine.—Quinine, which was formerly recommended in pneumonia by Galbraith, has more recently been reintroduced by Solomon Solis-Cohen, who administers full doses of a soluble double preparation of quinine, **quinine and urea hydrochloride**, hypodermically. The initial dose is 15 to 25 grains (1 to 1.6 Gm.). In three or four hours the same dose is repeated, and if the action of the drug and the severity of the symptoms indicate, a third and even a fourth dose is administered. This treatment is repeated on the second day, and if necessary on the third. Thus in the first forty-eight or sixty hours from 90 to 150 grains (6 to 10 Gm.) of the quinine compound are given. Doses of 5 to 10 grains (0.3 to 0.6 Gm.) are then given by mouth daily for several days. For hypodermic use the drug is prepared in a 50 per cent. solution in sterile water, which is injected deeply into a muscle through the skin, previously painted with tincture of iodine. The syringe must be emptied thoroughly before withdrawal, and iodoform collodion is used to seal the point of puncture.

The effect of the quinine treatment consists in a progressive and parallel fall in the temperature and pulse rate, a more rapid drop in the rate of breathing, and sometimes a rise in the blood-pressure. Dyspnea and cough are relieved, delirium subdued, and the patients rendered far more comfortable. Although the physical signs remain unchanged, lysis usually occurs instead of crisis

between the fifth and the fifteenth day. The mortality under this treatment has not been over 10 per cent. in Solis-Cohen's experience, and the method has gained considerable popularity. It is recommended that the urine be kept alkaline with ammonium compounds or sodium bicarbonate during the treatment.

The death rate from pneumonia for 40 years, according to good authority, has ranged between 20 and 22 per cent., and, in the last decade, between 30 and 40 per cent. Both the mortality and the number of cases are increasing. Attention is therefore called to the comparatively favorable result, viz., a mortality of from 9 to 12 per cent., attending the following special method of treatment:—

Apart from fresh air, dependence is placed (1) on massive doses of **quinine** and **urea hydrochloride** introduced intramuscularly in a 50 per cent. solution; (2) hypodermic injection of **cocaine hydrochloride** solution, or an **extract of the posterior lobe of the pituitary**, for the maintenance of blood-pressure; (3) in cases of prolonged fever, delayed resolution, or tardy convalescence, on the injection of **bacterins** (pneumococcus or "mixed" vaccines, personal or stock).

The initial dose of the quinine salt is from 15 to 25 grains (1 to 1.6 Gm.), followed by 15 grains (1 Gm.) every third hour, till the temperature falls and stays down below 102.2° F. (39° C.). One-half grain (0.03 Gm.) of cocaine hydrochloride or of **caffeine sodiosalicylate**, or 1 c.c. of pituitary liquid or 1 c.c. of the 1:1000 solution of the posterior pituitary principle, is given with the first quinine dose and repeated likewise every third hour until the systolic blood-pressure curve in millimeters of mercury taken in the arm rises and remains above the curve representing curve frequency in beats per minute. No invariable maximum limit has been fixed to the number of injections of

quinine or pressor substances, but it has not been considered best to continue the three-hourly injections beyond the first twenty-four hours and only occasionally as long as this. The writer gives the first dose of **quinine** to every patient himself. The cases become so much milder that they require no further treatment beyond good nursing. The quinine is seldom continued beyond seventy-two hours; the number of injections ranges from 1 to 15 and is ordinarily 5 or 6, usually of about 1 Gm. (15 grains) each. The number of cocaine and pituitary injections ranges from 1 to 20 and averages 3 or 4 in each case. S. Solis-Cohen (Jour. Amer. Med. Assoc., July 12, 1913).

Experiments suggest that a part of the curative effect of **quinine** and **urea hydrochloride**, **ethylhydrocupreine**, and other cinchonics in pneumococcus infections is due to their influence on phagocytosis. (Kolmer, Cohen and Steinfeld (Jour. Infect. Dis., Mar., 1917).

In **quinine** and **urea hydrochloride** we have a definite treatment of pneumonia as opposed to the usual expectant method. Cases with marked toxemia are afforded a much better chance of recovery. It makes the patient much more comfortable; allows of natural sleep, and the disease produces less strain upon the heart and system at large. Matthew (Edinburgh Med. Jour., Apr., 1918).

Creosote Carbonate.—Creosote carbonate (creosotal) has been credited with excellent effects in pneumonia by Van Zandt and W. H. Thomson. The dosage employed is 7½ to 15 grains (0.5 to 1 Gm.) every two or three hours in capsules. One of us (Sajous, Sr.) warmly recommends the use of creosote carbonate in conjunction with **saline solution**, as already described. As in the quinine treatment, lysis generally replaces crisis. A reduction of the mortality to 5 per cent. with this agent has been claimed.

Fluxion is diminished by the quieting effect on the heart and diuresis.

Following drug combination used in 20 cases of lobar pneumonia, with no mortality, but with abortion of 4 of the cases: **Potassium iodide**, 1 dram (4 Gm.); **creosote**, $\frac{1}{2}$ dram (2 Gm.); **alcohol**, 2 drams (8 c.c.); fluid-extract of **licorice**, 3 drams (12 c.c.); water to 6 ounces (180 c.c.). A tablespoonful is to be taken every four hours. Mathison (Brit. Med. Jour., Nov. 19, 1910).

Creosote carbonate in 15-grain (1 Gm.) doses every two or three hours, in a specially prepared emulsion, changes the course of the fever so that in 70 per cent. of cases it ends by lysis instead of crisis. The formula for the emulsion is:—

℞ *Acaciæ* 18 Gm. ($4\frac{1}{2}$ dr.).
Aquæ 18 c.c. ($4\frac{1}{2}$ dr.).
f. mucilaginem tunc adde
Creosoti carbo-
natis 21.33 c.c. ($5\frac{1}{4}$ dr.).

Misce et adde:—

Glycerini 30 c.c. (1 oz.).
Aquæ menthæ
piperitæ ...ad 240 c.c. (8 oz.).

Sig.: One tablespoonful (15 grains—1 Gm.—of creosote carbonate) every two or three hours.

W. H. Thomson (Med. Rec., April 1, 1911).

The author sums up the treatment of pneumonia and bronchitis as follows: Give a **creosote** preparation freely from the beginning in all cases. Use **collargol** in all cases of small children, preferably by inunction. In cases of older persons, where there is a suspicion of an infection other than the pneumococcus, use it also. Rubbing in an ointment of collargol is the most satisfactory way of giving this drug to small children. When the skin is hot and dry it is taken up very rapidly. It may also be given by enema: Wash out the bowel and, when it has become quiet, inject 10 grains (0.65 Gm.) of collargol dissolved in 4 ounces (120 c.c.) of warm

water, once or twice daily. If necessary, an opiate may be used to counteract irritability of the bowel. By mouth, much greater care is required than in other methods, because of the sensitiveness of collargol to acids. The author prescribes by mouth collargol, 20 to 50 grains (1.3 to 3.2 Gm.); sodium bicarbonate, 2 to 3 grains (0.13 to 0.2 Gm.); distilled water, 2 ounces (60 c.c.). M. Sig.: Tea- or dessert- spoonful on an *empty stomach* 3 to 12 times a day, followed by a glass of alkaline water.

Where only liquid food (not sweet milk) is being taken, no food should be ingested for two hours before or one hour after the medicine.

The remedy may also be taken in capsules, with a small drink of water at the time of taking and a large one about fifteen minutes later, when the capsule has had time to dissolve. I. L. Van Zandt (Texas State Jour. of Med., Dec., 1912).

Camphor.—Subcutaneous administration of large doses of camphor in 30 per cent. solution in sterile cottonseed or olive oil is asserted by Seibert to be, in some degree, a specific measure. The drug is presumed to act directly on the pneumococcus. The dose of the 30 per cent. oily solution is $2\frac{1}{2}$ fluidrams (10 c.c.) for every 100 pounds of body weight. The injections are given at twelve-hour intervals, except in the most severe cases, in which the interval is reduced to six or eight hours.

Good results in pneumonia obtained by the frequent administration of **camphor** internally. Cachets containing 0.12 Gm. (2 grains) should be given every two hours from the beginning of the disease. Where the condition becomes bad, the drug should be injected subcutaneously every half or even every quarter of an hour. After the crisis, the cachets are continued every three hours for a day or two, then 3 or 4 times daily; the subcutaneous route is reserved for cases where gas-

tric disturbances appears. In a series of 120 hospital cases of pneumonia treated with camphor, the mortality was but 2.5 per cent. One patient received the maximum dose of 12 Gm. (3 drams) daily for four days, without ill-effect. Svoekhotoff (Arch. gén. de méd., April, 1912).

In the Seibert camphor treatment of pneumonia, a 30 per cent. preparation of camphor in oil of sesame is used. In preparing the remedy the oil to be sterilized should be put in a bottle with a loosely fitting stopper, the sterilization taking place in a boiling-water bath. Whenever the preparation is to be used it should be drawn (not poured) into the sterilized syringe, care being taken to prevent loss of camphor by volatilization. As soon after the initial chill as possible, 10 c.c. or 2½ drams (equal to 36 grains of pure camphor) per 100 pounds of body weight should be injected hypodermically. This should be repeated every twelve hours except in bilateral pneumonia and in severe toxemia, in which case the injections should be given every six to eight hours. The injection should be given at the outer thigh or the abdomen. The point of injection should be carefully sterilized by washing and application of tincture of iodine. The injection should be made slowly and the oil gradually deposited below the subcutaneous fatty tissue and not into it. If these simple precautions are carried out, there will be no trouble either in the form of abscess, sloughing of the skin, or immediate discomfort following the injections. W. J. Cruikshank (New York State Journal of Medicine, February, 1914).

Camphor and **digitalis** employed as a routine treatment in bad cases of pneumonia with excellent results. Analysis of 548 cases of croupous pneumonia in a Petrograd hospital showed a mortality of 6.6 per cent. after camphor treatment against 9.9 per cent. after the usual treatment. Among the patients who did not receive the camphor a considerable number were not seriously ill and

would have recovered under any treatment. In the administration of camphor, the author noted a marked improvement in the respiration, lowering of the temperature, diminished expectoration, and a return of appetite and vigor. The termination was always by lysis. Ten c.c. of a 20 per cent. solution in oil was injected twice daily. No untoward effects were observed, due to slow and continuous absorption from the depot of camphor at the site of injection. The beneficial effects are credited to the action of the drug on the heart and vasomotor centers and its antiseptic action on the pneumococci. Markovitch (Roussky Vrach, June 7, 1914).

The large amounts of **camphorated oil** now frequently injected in the treatment of pneumonia, collapse, acute peritonitis, etc., sometimes leave annoying local indurations, and may even lead to abscess formation. To avoid this a solution more rapidly absorbed is needed, viz.,

R Camphoræ gr. xv (1 Gm.).
Ætheris ℥xxj (1.3 c.c.).
Olei olivæ ʒiiss (10 c.c.).

M. et ft. solutio.

The olive oil should previously have been washed with alcohol and sterilized. Clinical experience with the foregoing solution clearly showed its superiority over the official camphorated oil. Crouzon (N. Y. Med. Jour., from Bull. et mém. de la soc. méd. des hôp. de Paris, Apr. 24, 1914).

Digitalis.—Full doses of digitalis have been recommended by Petresco as a means of aborting the disease. The dosage employed was 1 to 2 drams (4 to 8 Gm.) of powdered digitalis-leaves per diem. The method has not found favor, and has, seemingly, been shown to increase rather than decrease the mortality from the disease.

Ethylhydrocupreine hydrochloride, a salt of a derivative of cupreine, an alkaloid closely related chemically to

quinine, was given internally in cases of pneumococcic lung inflammation, with good results. The dose was usually 0.5 Gm. ($7\frac{1}{2}$ grains) three times a day, the daily amount not exceeding 1.5 Gm. (23 grains). Usually the drug was given only on the first day or two of the disease. In 9 cases no other medication was employed; in all of these the temperature fell more rapidly, by crisis or lysis, than with other methods of treatment. The drug unquestionably inhibits the growth of the pneumococcus, particularly if used in the early stages of the disease. Where there was no effect, the pneumonia was generally dependent upon some other infection. No untoward after-effects were observed, although 1 patient took altogether 9.5 Gm. ($2\frac{1}{3}$ drams). H. J. Vetlesen (Berl. klin. Woch., Aug. 11, 1913).

Specific Treatment.—Pneumococcus Vaccine.—Conclusive evidence has been accumulated that the pathological conditions due to acute pneumococcic infection can be relieved, or at least modified, by the subcutaneous injection of killed bacteria of the species responsible for the condition. Although the effects of vaccines have varied in the hands of different observers, a gradual improvement in the results obtained has been noted. Leary, in a series of 83 cases, including many severe ones, had a mortality of only 8, or 9.7 per cent. G. W. Norris calls attention to the fact that if a stock vaccine is used, one should be reasonably sure that pneumococcic infection actually exists. Sudden onset with chill and pain in the side, high leucocytosis, herpes, rusty sputum, and the presence of the pneumococcus in the sputum constitute fairly good evidence of a pneumococcic infection, where one is unable to secure a blood-culture or time is

lacking. Preparation of an autogenous vaccine from a blood-culture, though more accurate, requires laboratory facilities and involves the risk of having the first culture prove sterile.

Vaccine treatment, to yield optimal results, should be begun as soon as the diagnosis is made. An injection of 50 million bacteria (according to Bispham) generally suffices as an initial dose, though some sthenic cases respond more favorably to larger doses, up to possibly 150 million. Subsequent doses should be increased rapidly to 100 million on the second day, 200 million on the third, etc., unless the temperature has abated after the first injection, when further treatment is, for the time, unnecessary. Marked relief from pain and dyspnea is generally procured by the treatment (Bispham). Norris, administering 50 million bacteria every fifth day, observed that a large proportion of his cases had early crises, and that an unusual number of apparently hopeless cases recovered. Nearly all cases showed a marked increase in leucocytosis.

Stock **pneumobacterins**, in doses of 25 to 600 millions, used in 20 cases, with 15 per cent. mortality; 30 other similar cases, under usual methods of treatment, showed 40 per cent. mortality. The results seemed more definite with the larger doses. The dosage can be adjusted according to the clinical phenomena; where malaise, headache, chilliness, or definite rigors, with rise of temperature, follow an injection, it is unwise to increase the dose. Robertson and Illman (Penna. Med. Jour., Jan., 1912).

The writer has had a number of cases of pneumonia in which vaccine was given within a few hours of the

initial chill and, though the diagnosis was beyond question, the whole process was over in 48 or 72 hours. The best method or procedure is to administer a **polyvalent stock vaccine** of the pneumococcus and streptococcus, of each 30 million, as early as possible. Make sputum smears and cultures,—blood-cultures in early cases, lung puncture in late ones,—and proceed to the preparation of an autogenous vaccine. If there is no definite response in 24 or 48 hours, repeat or preferably give an autogenous vaccine. If there is no response in 36 or 48 hours, double the dose. If there is a response, as evidenced by improved clinical symptoms and signs, defer reinoculation 3 days, or until the first symptoms of retrogression in the general condition or the physical signs occur. Maintain the dosage or increase it every 2 or 3 days until the patient is entirely well. Generally about 3 doses are necessary. In 20 consecutive cases seen by the writer in private practice, there was but 1 death. In altogether over 100 cases, the disease was observed to run a shorter course; the patients were less toxic, there was less fever, and generally no delirium occurred except in alcoholic cases. Convalescence was shortened and the danger of complications lessened; 20 to 30 grains (1.25 to 2 Gm.) of **sodium citrate** should be given every 2 to 3 hours in severe cases. H. A. Craig (Med. Rec., Dec. 27, 1913).

The writer makes it a practice to inject 400 to 500 million stock pneumococci in every case of lobar pneumonia as soon as the diagnosis is made. This is followed in two or three days by a second injection of the same or a slightly smaller dose. The results have been very favorable compared with those in control cases. Excluding 1 patient who died of uremia, the mortality in a series of 19 cases was but 10.5 per cent. In some patients the injections are followed by a drop in temperature to normal, a rapid clearing up of the toxemia, and marked symptomatic

amelioration; in others the drop in temperature—to or below normal (a pseudocrisis)—is followed by a moderate rise, and this in turn by lysis to normal in one or two days; finally, in a third group there is no appreciable benefit. The writer has never noticed any marked favorable influence in clearing up the physical signs immediately after the crisis or termination of toxic symptoms; but in cases of distinctly delayed resolution, especially when toxic symptoms caused by a secondary infection or the lighting up of a former infection,—*e.g.*, tuberculosis appears,—**vaccines** again become useful, particularly when given with due regard to the etiological organisms present. G. M. Illman (International Clinics, ii, 23, 1914).

Where lung consolidation is due to the bacillus of Friedländer, streptococci, etc., or where these organisms complicate a pneumococcic consolidation, corresponding vaccines must be used if a favorable result is to be obtained.

E. C. Rosenow, of Chicago, has found it possible, by partial autolysis of pneumococci in salt solution, to separate from the virulent organisms a large portion of the useless toxic material contained in their bodies, leaving in them that part which stimulates antibody formation. By using such a preparation antibody formation can be excited more promptly and energetically without the production of an initial "negative phase." A much larger number of bacteria can be injected than in the case of those merely killed by heat. The autolysis is interrupted when almost all the cocci have lost their affinity for the Gram stain. In a series of 146 cases—nearly one-half bad alcoholics—from 10 to 15 *billion* of the autolyzed organisms were given daily till the temperature

reached normal. The mortality was 23.2 per cent. In 148 similar control cases, not given the vaccine, the mortality was 37.8 per cent. (See also BACTERIAL VACCINES, vol. ii.)

Antipneumococcus Serum.—Some difficulty in serum treatment of pneumonia has been experienced owing to the fact that differently reacting groups of pneumococci exist, and that serum produced for one group fails against the other groups. Immune serums against two of the most important groups have been produced, and this treatment has been applied clinically to some extent, with promising results. Attempts have also been made to secure a polyvalent serum. In infections by Type I pneumococci, a distinct reduction in mortality has been secured by the use of serum.

As desensitizing doses the writers inject 2 to 4 c.c. of **serum**. For treatment 100 c.c. of serum is the dose generally used. This is diluted with 100 to 150 c.c. of normal salt solution, heated to slightly above the body temperature, and injected in the course of half an hour into the vein, the conducting tubes being warmed with hot-water bottles. The reaction that follows is never the same in any 2 patients, neither is it the same in a given patient when the serum is exhibited more than once. The typical reaction may be divided into 4 stages, the first being that of irritability; the second, shock; the third, hyperpyrexia, and the fourth, relaxation. Friedlander and Runnels (Milit. Surg., Mar., 1918).

The death rate in 538 cases untreated with serum was 45.3 per cent., and in 115 treated cases, 20.8 per cent. The **antipneumococcus serum** used was produced by injecting massive doses of virulent pneumococci into domestic fowls. P. Kyes (Jour. Med. Research, July, 1918).

Description of a rapid method for the determination of the type of pneumococcus. Sputum of satisfactory

quality will coagulate if the test tube in which it has been poured is placed in boiling water for several minutes. The clot is broken up and the fluid separated from it added to the type sera. With positive sputa the readings are usually made in 15 or 20 minutes after receipt of specimen. About 3 c.c. of sputum is desirable for the test. Of 183 sputa received, 129 were satisfactory for this method of testing. In type I cases, it was possible to send the serum back with the messenger who delivered the sputum, which resulted in the serum being administered within half an hour instead of the usual 24 hours. C. Krumwiede (Trans. N. Y. Acad. of Med.; N. Y. Med. Jour., Aug. 3, 1918).

Report of a series of cases in which **serum** treatment was begun on the first clinical sign, without waiting for differentiation of type. For this purpose **polyvalent serum** was used. If the case showed **Type I**, this **serum** was used, otherwise polyvalent serum was continued. The amounts of serum given ranged from 50 c.c. to 600 c.c., with an average of 250 c.c. About 50 per cent. of cases showed signs of serum reaction, ranging from simple erythema to extensive urticaria, with general swelling and joint pains. Manifestations appeared 12 to 14 days after. Camac (Amer. Jour. Med. Sci., Dec., 1918).

Eighty per cent. of pneumococcic infections fall serologically into 3 groups called fixed Types I, II, III. The remaining 20 per cent., called Group IV, comprises numerous distinct races. Group IV may be found in 80 per cent. of normal mouths. The fixed types are found only in the mouths of those recently ill or in one who has been in contact with a type case. This points to carriers of fixed types as the chief epidemiologic factor. About 38 per cent. of all cases are Type I; about 30 per cent., Type II, and about 11 per cent., Type III. Against Type I an immune serum has been produced which reduces mortality by three-fourths; against Type II, a less potent serum which reduces

mortality by about one-half. All cases of pneumonia should be typed as early as possible in order to give patients the benefit of antiserum, if of Type I or II. Even if one of the Type I cases shows sensitiveness to the serum, an attempt should be made to desensitize, in order to make Serum I available. Serum should be given as early as possible and in 100 c.c. amounts at 8-hour intervals for at least 3 doses, intravenously. Grouping not only makes serum therapy available, but aids in prognosis, the order of increasing mortality, without serum, being IV, I, II, III. Redden (U.S.N.Med. Bull., Jan., 1919).

Antipneumococcus serum used in 71 cases of acute pneumonia, 3 of generalized pneumococcus infection, and 8 of bronchopneumonia. Except in the latter group, the results were highly favorable. The writer injects 50 or even 60 or 70 c.c. as soon as he recognizes pneumonia, and follows with 40, 30 and 20 c.c. on the next few days, until the second or third after the drop in the temperature. Defervescence is hastened, and toxemia rapidly attenuated. The number of complications is reduced. The average death rate in pneumonia is 12.9 per cent.; in the serum treated cases it was 7.5 per cent. Lassance (Presse méd., Jan. 23, 1919).

Treatment of Complications and Atypical Forms.—Cardiac Complications.—In **endocarditis**, cold should be applied locally and **absolute rest** enjoined. If amelioration does not result, **precordial counterirritation** should be practised. In **pericarditis**, extensive serous effusion or purulent effusion in the pericardium requires **paracentesis** or **pericardotomy**.

Meningitis.—Where meningitis develops, **lumbar puncture** should be practised and **antipneumococcic serum** administered. For further details the reader is referred to the article on MENINGITIS.

Hiccough.—**Morphine** injected hypodermically may, in addition to inducing sleep, relieve the hiccough permanently. In some instances the administration of sugar upon which **compound tincture of cardamom** and **compound spirit of ether**, 10 drops of each, has been dropped, will suffice to arrest the symptom. In the more obstinate cases **musk** may be given in doses of 1 grain (0.06 Gm.) in a capsule every three hours, in conjunction with **morphine** injections or **sodium bromide**.

Tympanites.—Milk should be discontinued, free **purgation** induced, hypodermic injections of **physostigmine** in doses of $\frac{1}{100}$ to $\frac{1}{50}$ grain (0.0006 to 0.0012 Gm.) or of **pituitary extract** administered, and means taken to raise the blood-pressure, if low.

Occasionally meteorism in pneumonia is a manifestation of toxic paresis of the intestines. As soon as this form of tympanites is suspected, an **enema of asafetida** made by rubbing up 75 grains (5 Gm.) of the drug in 3 ounces (90 Gm.) of yolk of egg, should be thrown high up into the colon. In addition, **heat to the surface** and a drink of **hot coffee**, hypodermics of **musk** and, perhaps, of **camphor** are highly serviceable. The writer has great faith in musk as a cardiac stimulant, and he always keeps it in reserve. The formula for its preparation is: Good *Tontine musk*, 1 Gm. (15 grains); *sodium benzoate*, 0.5 Gm. ($7\frac{1}{2}$ grains), and *distilled water*, 15 c.c. ($\frac{1}{2}$ ounce), of which the dose is 15 to 30 minims (0.9 to 1.8 c.c.), (1 to 2 grains—0.065 to 0.13 Gm.—of the musk), injected beneath the skin. In urgent cases this is injected hourly. Babcock (Ill. Med. Jour., Apr., 1912).

Acute Gastric Dilatation.—Where collapse, together with splashing in the stomach and excessive peristal-

sis are noted as signs of this condition, **lavage of the stomach** through a tube should be at once performed and repeated thereafter according to indications. The patient should be placed on the right side. Hypodermic administration of **physostigmine** may be tried. No food or water should be given by the mouth; **rectal feeding** may be substituted.

Edema of the Lungs.—In this serious complication **cupping** and **venesection** are important measures. **Atropine**, with or without **morphine**, should be given hypodermically, the circulation stimulated and **hot mustard foot-baths** administered.

Cardiac failure, its most important cause, demands the prompt use of **digitalis** or, in urgent cases, **strophanthin intravenously**, in doses of 0.5 mg. ($\frac{1}{12}$ grain). **Venesection** is useful to reduce venous congestion. **Caffeine** is helpful as a respiratory stimulant and to promote diuretic action. **Oxygen** inhalations tend to improve the circulation and the oxygenation of the blood, while reducing the acidosis due to the asphyxial condition caused by the edema. **Sodium bicarbonate** should be given orally for the same purpose, or by intravenous injection but administering not over 400 c.c. (13 ounces) of a 10 per cent. solution. Tympanites may be relieved by the use of **pituitary extract**. W. A. Bastedo (Jour. Amer. Med. Assoc., Sept. 8, 1917).

Delayed Resolution.—When not due to empyema or tuberculosis, delayed resolution particularly demands attention to the patient's general state of health and nutrition. Externally, **counterirritation** with **iodine**, **blisters**, or the **thermocautery** may be instituted, internally sodium or calcium iodide should be given. **Fibrolysin** injections and the use of the **X-rays** have also been advised. **Deep**

breathing appears sometimes useful.

For the treatment of complicating pleurisy, empyema, abscess, and gangrene of the lung the reader is referred to the articles: **PLEURA, DISEASES OF**, and **LUNG, DISEASES OF**.

In serofibrinous pleuritis or empyema secondary to pneumonia, expectant treatment, unless **thoracocentesis** be urgently needed, should be adopted until the crisis has been passed. If the latter fail to appear at the proper time, then the **exudate** should be **promptly withdrawn**. If crisis takes place in due season, a serofibrinous effusion is quickly absorbed in some cases at least; if not, recovery should be favored by **puncture followed by aspiration**. Quinine which is sometimes helpful, may be administered in 4-grain (0.26 Gm.) doses in capsule, followed immediately by a few drops of dilute **hydrochloric acid**, four times daily. Anders and Morgan (Jour. Amer. Med. Assoc., Oct. 7, 1911).

Alcoholic Pneumonia.—In this type of case sufficient **alcohol** should be given to avoid the otherwise inevitable collapse. Manifestations of excessive nervous excitation should be subdued with the aid of such drugs as **chloral hydrate**, **paraldehyde**, **morphine**, and **scopolamine**.

Bilious Pneumonia.—Special care should be taken to activate elimination through the kidneys, intestine, and skin. **Saline enteroclysis** or **hypodermoclysis** and the administration of **salicylates** are indicated. Where malarial infection is known to exist **quinine** should be given.

Treatment During Convalescence.—During convalescence the administration of **bitter tonics**, **iron**, **strychnine**, **quinine**, **phosphorus** in cod-liver oil or the **hypophosphites**, **arsenic** or **calcium lactate**, is frequently of advantage. Ample **rest** and a

generous diet, deep breathing, massage, and at times temporary removal to a more favorable climate are also useful measures. Where a troublesome cough, with free expectoration, follows the pneumonia, such remedies as compound tincture of benzoin and terebene are appropriate and efficient. Sufficient time should be permitted, before allowing normal latitude in the patient's movements and conduct, for restoration of the lung-tissue and myocardium to their normal state.

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PNEUMONITIS. See PNEUMONIA, LOBAR.

PNEUMONOKONIOSIS. See LUNGS, DISEASES OF.

PNEUMOPERICARDIUM. See HEART AND PERICARDIUM, DISEASES OF.

PNEUMOTHORAX. See PLEURA, DISEASES OF.

PODAGRA. See GOUT.

PODOPHYLLUM. — Podophyllum, U. S. P. (mandrake, or May-apple), is the rhizome and rootlets of *Podophyllum peltatum* (family, Berberidaceæ), a plant (Umbrella plant or Duck's foot), indigenous to the United States and Canada. This plant yields 3½ to 5 per cent. of resin, a coloring principle,—saponin,—gum, starch, gallic acid, fixed oil, salts, etc. It contains no distinctive alkaloid; berberine however, is present. The active principle, according to Podwissotsky, is a neutral crystalline body,—picropodophyllin,—which exists in combination with picropodophyllic acid; the resulting combination he calls podophyllotoxin.

The official resin of podophyllum consists, in reality, of two resins: one is soluble in both ether and alcohol, the other only in alcohol. The former, pres-

ent to the extent of 75 to 80 per cent., is the active part. It occurs in light-yellow powder or in small, yellowish, bulky, fragile lumps, having a faint odor and an acrid, bitter taste. The resin is very irritating to the eyes and may cause conjunctivitis.

PREPARATIONS AND DOSES.—*Podophyllum*, U. S. P. (seldom used), 5 to 20 grains (0.3 to 1.20 Gm.).

Fluidextractum podophylli, U. S. P. (fluidextract), 5 to 15 minims (0.3 to 1 c.c.).

Resina podophylli, U. S. P. (podophyllin), ⅛ to 1 grain (0.008 to 0.06 Gm.).

Pilulæ catharticæ vegetabiles, N. F. (vegetable cathartic pills): Compound extract of colocynth, 1 grain (0.6 Gm.); extract of hyoscyamus, ½ grain (0.03 Gm.); resin of jalap, ⅓ grain (0.02 Gm.); extract of leptandra and resin of podophyllum, of each, ¼ grain (0.015 Gm.); oil of peppermint, ⅛ grain (0.008 Gm.). Dose, 2 pills.

Pilulæ aloes et podophylli compositæ, N. F. (compound pills of aloes and podophyllum; Janeway's pills): Aloes, 1 grain (0.065 Gm.); resin of podophyllum, ½ grain (0.0325 Gm.); pilular extract of belladonna leaves and extract of nux vomica, of each, ¼ grain (0.016 Gm.). Dose, 1 pill.

Pilulæ aloes, hydrargyri et podophylli, N. F. (pills of aloes, mercury and podophyllum; triplex pills): Aloes, 2 grains (0.13 Gm.); mass of mercury (0.065 Gm.); resin of podophyllum, ¼ grain (0.016 Gm.). Dose, 1 pill.

POISONING BY PODOPHYLLUM.—Podophyllum, or podophyllin, in large doses is a drastic cathartic; in toxic doses it causes violent gastroenteritis, with vomiting, excessive purging, violent abdominal pain, and collapse or convulsions.

Treatment.—The treatment consists in giving opium to relieve the pain and check peristalsis, stimulants to sustain the patient, and demulcent drinks to soothe the irritated mucous membrane. Other indications will be afforded by the symptoms in each case.

THERAPEUTICS.—Podophyllum is a useful cathartic in constipation when the glandular secretions of the intestines and liver are deficient. Habitual constipation due to impaired action of the muscular

coat of the bowel may be removed by the nightly use of a small dose of the resin, $\frac{1}{4}$ to $\frac{1}{2}$ grain, combined with the extract of belladonna, $\frac{1}{4}$ grain, and the extract of physostigma, $\frac{1}{4}$ grain (Bartholow). **Bleeding hemorrhoids** caused by stasis in the portal circulation, if of recent formation, may sometimes be cured by a full dose of podophyllum ($\frac{1}{2}$ to 1 grain). Podophyllum is useful in a variety of hepatic disorders: In **functional hepatic disturbances, portal congestion, and catarrhal jaundice**. The **digestive disturbances of malarial infection** may be relieved by a podophyllum purgation. **Sick-headache** associated with loose and dark-colored stools are amenable to podophyllum.

The smallness of the dose and slight taste of the resin make it serviceable in the treatment of **constipation in young children** or in **diarrhea due to diminished secretion**. When hard, stony stools occur in children one or two months old, a grain (0.06 Gm.) of the resin may be dissolved in a drachm of alcohol (or spirit of ginger) and two drops or more of this on sugar may be given once or twice a day. In the **summer diarrhea of children**, with watery passages having a musty or mousy odor, the resin may be given in doses of $\frac{1}{60}$ to $\frac{1}{50}$ grain (0.001 to 0.002 Gm.), repeated each few hours. In these small doses the resin will often stop **vomiting** if the liver is torpid and the stomach depressed. It is obvious that it should not be given if the vomiting is due to gastric irritation or inflammation. S.

POLIOENCEPHALITIS. See BULBAR PARALYSIS, AND MENINGES AND BRAIN, DISEASES OF.

POLIOMYELITIS. See SPINAL CORD, DISEASES OF.

POMEGRANATE. See PELLETIERINE.

POMPHOLYX (Dysidrosis; Cheiropompholyx).—Pompholyx is an acute exudative, contagious disease, characterized by the formation of deep-seated vesicles, which after a few days terminate by spontaneous rupture or absorption and are

followed by a slight desquamation of the epidermis. The eruption is symmetrical in its distribution, but is usually limited to the sides of the fingers and the palms of the hands. More rarely it appears on the soles of the feet and other portions of the body. At first, minute, isolated, transparent vesicles, deeply imbedded in the skin, they slowly increase in size, and become whitish or opaque, resembling rice-grains or sago beneath the epidermis. Resolution by absorption may now take place, but usually the exudation continues, the vesicles become larger and elevated above the surface, and may by coalescing form large bullæ. Absorption now causes the gradual disappearance of the vesicles, or rupture of the walls of the vesicles and bullæ ensues, with escape of their contents. The desquamation of the epidermis exposes a reddened, abraded, non-suppurating surface which rapidly heals. Slight itching and burning, with more or less nervous depression, accompany the eruption. Stiffness of the hands and fingers often result if the eruption is extensive. Pompholyx of the face may produce painful fissures.

DIAGNOSIS.—The presence of itching and burning distinguishes this from **sudamina**. Though some cases may resemble **eczema vesiculosum**, the subjective symptoms of the latter are more intense, the surrounding surface is hot and reddened, and the eruption of the vesicles results in the formation of crusts and leaves an exuding surface.

TREATMENT.—Full doses of **Fowler's solution** or **arsenic trioxide** exert a specific effect, and should be continued until all traces have disappeared. **Quinine, iron, strychnine**, and the **mineral acids** are useful, combined with a **nourishing diet**. Locally any **soothing ointment** will relieve the itching and burning and protect the abraded surface left after desquamation. W.

PONOS.—Ponos, or infantile kala-azar, is a subacute or chronic disease due to *Leishmania infantum* Nicolle. It clinically closely resembles Indian kala-azar, but occurs in childhood.

SYNONYMS.—Febrile splenic anemia (Fede), *Anæmia infantum a Leishmania*

(Pianese), *Leishmania anæmia* (Jemma and di Cristina), *Ponos* (Greece), *Malattia da mensa* (Sicily), *Marda tal biccia* (Malta).

SYMPTOMS.—The invasion is very slow and insidious, the first warning being some alimentary disturbance in the child, such as an attack of vomiting and diarrhea, with or without some enlargement of the spleen. As the child is anemic and has very irregular fever, the disease might be mistaken for malaria, especially as some attacks appear suddenly and are associated with rigors. Attacks of diarrhea alternating with constipation, attacks of irregular fever marked by apyrexial periods, and epistaxis appear and the child becomes pale and listless.

Somewhat later the spleen enlarges and protrudes from under the ribs. The febrile attacks become more marked, hemorrhages from the nose, gums, and under the skin occur, and the diarrhea or dysentery becomes more severe. Wasting and progressive anemia now appear, the face, conjunctiva, and the whole body assuming a peculiar white tinge.

The fever is very irregular; exacerbations may occur morning and evening, sometimes several times a day. High temperature may appear in cycles, or sudden falls to subnormal may be observed. The fever and pulse rate do not always go hand in hand; the latter is quite constantly rapid even during apyrexia, but may rise to 150 or 160 during the febrile period.

The blood shows a decrease in the erythrocytes ($1\frac{1}{2}$ to 3 millions) and in the hemoglobin (below 50 per cent.), and also in the leucocytes (1500 to 3000), which consist mostly of medium-sized cells. The mononuclears (70 to 80 per cent.) are increased at the expense of the polymorphonuclear cells, which furnish the remaining 20 or 30 per cent. Some poikilocytosis and anisocytosis are usually present, but nucleated cells are rare or absent.

Edema of the face, hands, feet, and genitalia may appear and disappear suddenly; it has a tendency to bilateral symmetry, but is influenced by the patient's position.

The liver usually becomes enlarged, but not to the extent of the spleen, the two combined causing enlargement of the ab-

domen and possibly some ascites. Although the urine is usually normal, there may be a diminution in the urea output, and at times slight albuminuria.

The child has a prematurely old appearance and the mental and physical powers become lessened. The bones, especially the ribs and scapulæ, become prominent, and death usually occurs from exhaustion induced by dysentery or diarrhea. Spontaneous recovery is rare.

DIAGNOSIS.—Ponos resembles *kala-azar*, sometimes very closely, but the former occurs in children and is inoculable into dogs, while the latter is seen mostly in young adults and is not inoculable into dogs. The temperature chart is, moreover, generally more irregular in ponos. The enlarged spleen, the irregular fever, and the pallor occurring in a child are the characteristic clinical symptoms. The parasite, however, is the positive factor in the diagnosis, and may be obtained by puncture from the spleen, liver and bone-marrow, or by vesication and examination of the fluid, and, if there are cerebral symptoms, by lumbar puncture. From *undulant fever* it is differentiated by the irregularity of the fever and an absence of the typical undulatory character; the spleen is more enlarged, the articular symptoms lacking, and Wright's agglutination test is negative. From *enteric fever* ponos is distinguished by the splenic enlargement, the irregular fever, and the absence of Widal's reaction. The absence of the plasmodium in the blood and the lack of influence of quinine on the fever would distinguish ponos from *malaria*. From *splenomedullary leukemia* it is distinguished by the leucopenia; from *syphilitic splenomegaly* by the history and the lack of effect from mercury and salvarsan; from *infantile afebrile splenomegaly*, in its various forms, by the fever and the parasite; from *rachitic splenomegaly* by the absence of bony deformities and by the presence of the parasite.

ETIOLOGY AND PATHOLOGY.—Ponos is due to *Leishmania infantum* Nicolle, a parasite which occurs in dogs and may be transmitted to them and to monkeys from the human subject. The fleas of the dog are believed to transmit the disease to human beings.

The spleen and liver are much enlarged, the lymphoid tissue in the former being greatly increased. The islands of Langerhans in the pancreas are hypertrophied, and there is an overproduction of myeloid and lymphoid tissues in the bone-marrow.

PROGNOSIS.—This is very unfavorable, though spontaneous cure does occur.

TREATMENT.—Treatment is most unsatisfactory. **Atoxyl, salvarsan, mercury benzoate and bichloride, sodium arsenate, and iron cacodylate with the X-ray** have been used with little success. W.

POTASSIUM.—Potassium, or kalium, is a white metal, discovered by Sir Humphry Davy in 1807, having the consistence of wax; the fresh-cut surface has a silvery luster, rapidly changing by oxidation to bluish or gray. Its affinity for oxygen is very strong. Exposed to the air, it oxidizes instantly. Thrown upon water it takes fire spontaneously, and burns with a beautiful purple flame, yielding an alkaline solution of potassa, or potassium hydroxide. Potassium hydroxide, or potassa, is a strong, alkaline base, very deliquescent, and soluble in half its weight of water. From this base the medicinal preparations are made. The metal is never used in medicine. Some of the preparations are strongly alkaline and have a high diffusive power; this group contains potassium hydroxide, potassium carbonate and bicarbonate. A second series is neutral in reaction and alkaliogenous (becomes alkaline by decomposition, the vegetable acid being replaced by carbonic acid, and an alkaline carbonate being formed); this group contains potassium acetate and citrate, of high diffusive power, and potassium and sodium tartrate and potassium tartrate, of low diffusive power. A third series is permanently neutral or acid; this

group contains potassium bitartrate and sulphate, of low diffusive power, and the nitrate, chlorate, dichromate, and iodide, of high diffusive power.

Upon a therapeutic basis, another useful classification may be made.

Caustics: potassa, potassa with lime (non-official), and potassium dichromate.

Purgatives: potassium bitartrate (4 to 8 drams—15 to 30 Gm.), potassium and sodium tartrate ($\frac{1}{2}$ to 1 ounce—15 to 30 Gm.), the acetate (2 to 4 drams—8 to 15 Gm.), and the sulphate ($\frac{1}{2}$ to 4 drams—2 to 15 Gm.).

Systemic antacids: the carbonate (10 to 30 grains—0.6 to 2 Gm.), the bicarbonate (20 to 60 grains—1.2 to 4 Gm.), the solution of the citrate (1 to 8 drams—4 to 30 c.c.), the acetate ($\frac{1}{4}$ to $1\frac{1}{2}$ drams—1 to 6 Gm.), and potassium and sodium tartrate (20 to 40 grains—1.3 to 2.6 Gm.).

Diuretics: the bitartrate (1 to 2 drams—4 to 8 Gm.), potassium and sodium tartrate ($\frac{1}{2}$ to 1 dram—2 to 4 Gm.), the acetate ($\frac{1}{4}$ to 1 dram—1 to 4 Gm.), the citrate $\frac{1}{4}$ to 1 dram—1 to 4 Gm.), the carbonates ($\frac{1}{8}$ to 1 dram—0.5 to 4 Gm.), the nitrate ($\frac{1}{6}$ to $\frac{1}{2}$ dram—0.6 to 2 Gm.), and the iodide ($\frac{1}{12}$ to 1 dram—0.33 to 4 Gm.).

Febrifuges: the solution of the citrate (1 to 8 drams—4 to 30 c.c.), the citrate (20 to 30 grains—1.3 to 2 Gm.), and the nitrate (10 to 30 grains—0.6 to 2 Gm.).

Alkaline solutions: solutions of the carbonate and the bicarbonate (1 to 2 drams—4 to 8 Gm.—to 1 pint—500 c.c.).

Antiemetic: the citrate of potassium ($\frac{1}{4}$ to 1 dram—1 to 4 Gm.).

PREPARATIONS AND DOSES.—The official preparations of potassium are:—

Potassii hydroxidum, U. S. P. (potassium hydrate, or hydroxide; caustic potash).

Liquor potassii hydroxide, U. S. P. (solution of potassa, 4.5 per cent.). Dose, 10 to 30 minims (0.6 to 2 c.c.).

Potassii acetat, U. S. P. (potassium acetate). Dose, 10 to 60 grains (0.6 to 4 Gm.).

Potassii bicarbonas, U. S. P. (potassium bicarbonate). Dose, 10 to 60 grains (0.6 to 4 Gm.).

Potassii dichromas, U. S. P. VIII (potassium dichromate). Dose, $\frac{1}{10}$ to 1 grain (0.006 to 0.06 Gm.). (See CHROMIUM.)

Potassii bitartras, U. S. P. (potassium bitartrate; acid tartrate of potash; cream of tartar). Dose, $\frac{1}{2}$ to 4 drams (2 to 15 Gm.).

Pulvis jalapæ compositus, U. S. P. (potassium bitartrate, 65 per cent.; jalap, 35 per cent.). Dose, $\frac{1}{4}$ to 1 dram (1 to 4 Gm.). (See JALAP.)

Potassii bromidum, U. S. P. (potassium bromide). Dose, 10 to 60 grains (0.6 to 4 Gm.). (See BROMINE.)

Potassii carbonas, U. S. P. (potassium carbonate; salt of tartar). Dose, 10 to 30 grains (0.6 to 2 Gm.).

Potassii chloras, U. S. P. (potassium chlorate). Dose, 5 to 10 grains (0.3 to 0.6 Gm.).

Trochisci potassii chloratis, U. S. P. (potassium chlorate, $2\frac{1}{2}$ grains—0.15 Gm.). Dose, 1 to 5 troches.

Potassii citras, U. S. P. (potassium citrate). Dose, 15 to 60 grains (1 to 4 Gm.).

Liquor potassii citratis, U. S. P. (solution of potassium citrate, 8 per cent.; neutral mixture). Dose, 1 to 8 drams (4 to 30 c.c.).

Potassii citras effervescens, U. S. P. (effervescent potassium citrate, con-

taining 20 per cent. potassium citrate; granular salt). Dose, 1 to 3 drams (4 to 12 Gm.).

Potassii cyanidum, U. S. P. VIII (potassium cyanide). Dose, $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.008 to 0.015 Gm.). See HYDROCYANIC ACID.)

Potassii et sodii tartras, U. S. P. (potassium and sodium tartrate, Rochelle salt). Dose, 1 to 8 drams (4 to 30 Gm.).

Pulvis effervescens compositus, U. S. P. (Seidlitz powder: sodium bicarbonate, 40 grains—2.5 Gm.—and sal Rochelle, 2 drams—7.5 Gm.—in blue paper; tartaric acid, 35 grains—2.15 Gm.—in white paper). Dose, 1 to 2 powders.

Potassii ferrocyanidum, U. S. P. VIII (potassium ferrocyanide; yellow prussiate of potash). Dose, $7\frac{1}{2}$ grains (0.5 Gm.).

Potassii hypophosphis, U. S. P. (potassium hypophosphite). Dose, 3 to 30 grains (0.2 to 2 Gm.). (See PHOSPHOROUS ACID.)

Syrupus hypophosphitum, U. S. P. (syrup of the hypophosphites). Dose, $2\frac{1}{2}$ drams (10 c.c.). (See PHOSPHOROUS ACID.)

Potassii iodidum, U. S. P. (potassium iodide). Dose, 5 to 60 grains. (See IODINE.)

Liquor iodi compositus, U. S. P. (Lugol's solution, potassium iodide, 10 per cent.; iodine, 5 per cent.). Dose, 3 minims (0.2 c.c.). (See IODINE.)

The best method of prescribing potassium iodide is: One ounce (30 Gm.) of the salt is dissolved in $5\frac{1}{2}$ drams (22 c.c.) of hot water. The solution is then brought to 1 ounce (30 c.c.) with distilled water. This always results in a solution representing 1 grain (0.06 Gm.) in each minim (0.06 c.c.), and, approximately, in each drop. Hynson (Bulletin of Pharmacy; Med. News, May 13, 1899).

Potassii nitras, U. S. P. (potassium nitrate; saltpeter; sal prunella). Dose, 5 to 15 grains (0.3 to 1 Gm.).

Potassii permanganas, U. S. P. (potassium permanganate). Dose, $\frac{1}{2}$ to 3 grains (0.3 to 0.2 Gm.). (See MANGANESE.)

Potassa sulphurata, U. S. P. (sulphurated potassa; liver of sulphur). Potassium polysulphides and thiosulphate, the sulphides corresponding to 12.8 per cent. of sulphur.

Antimonii et potassii tartras, U. S. P. (tartar emetic). Dose, $\frac{1}{40}$ to $\frac{1}{2}$ grain (0.0015 to 0.03 Gm.). (See ANTIMONY.)

Syrupus scillæ compositus, U. S. P. (Coxe's hive syrup—tartar emetic, 0.2 per cent.). Dose, 30 minims (2 c.c.). (See ANTIMONY.)

Mistura glycyrrhizæ composita, U. S. P. (Brown mixture—tartar emetic, 0.024 per cent). Dose, $2\frac{1}{2}$ drams (10 c.c.). (See ANTIMONY.)

Liquor potassii arsenitis, U. S. P. (Fowler's solution of arsenic, 1 per cent.). Dose, 3 to 10 minims (0.2 to 0.6 c.c.). (See ARSENIC.)

The following are semi-official:

Potassii sulphas, N. F. (potassium sulphate). Dose, $\frac{1}{4}$ to 4 drams (1 to 15 Gm.).

Syrupus hypophosphitum compositus, N. F. (compound syrup of the hypophosphites). Dose, 2 drams (8 c.c.). (See PHOSPHOROUS ACID.)

Unguentum potassii iodidi, N. F. (potassium iodide, 10 per cent.). (See IODINE.)

Vinum antimonii, N. F. (wine of antimony—tartar emetic, 0.4 per cent.). Dose, 15 minims (1 c.c.). (See ANTIMONY.)

PHYSIOLOGICAL ACTION.—

The potassium salts exert a poisonous action on the heart and a para-

lyzing action on the muscles and nerves, through their effect on protoplasm, and destroy the ozonizing function of the red blood-corpuscles. These effects are possessed in a varying degree by the different salts and are modified by the amount taken.

In physiological doses the potassium salts increase the secretions and stimulate catabolism by promoting oxidation. Long-continued use of the potassium salts, in appreciable amounts, is followed by anemia and emaciation. Concentrated solutions of potassium salts increase the rhythmic activity of the heart, and after thirty minutes produces a lasting contraction which Burridje attributes to a direct local action on its musculature. Lust also notes this tetanizing action of potassium.

In a case of tetany following on a severe gastrointestinal disturbance in a child of 2, the remarkable feature was that the tetany came on regularly when there was marked retention of water, and it subsided with this. The writer thinks it is evident that the tetany was due to substances retained in and with the water, and everything seems to point to the potassium salts in the water as the substances to be incriminated. He believes that potassium and sodium salts have a direct spasm-producing influence while lime has the opposite effect, reducing the tendency to spasms. The sodium and, still more, the potassium salts display their spasmogenic influence sometimes in doses no higher than the proportions of these salts usually present in milk. Lust (Münch. med. Woch., July 8, 1913).

The potassium salts with the vegetable acids (acetate, citrate, tartrate, etc.) are decomposed in the blood, the alkaline base combining with carbonic acid, and when excreted by the kidneys alkalinizes the urine.

The salts with the mineral acids (nitrate, sulphate, etc.) are not so decomposed, but, in passing through the body in the blood-stream, act more or less deleteriously on the blood elements (protoplasm and cells) and upon the various organs (nervous, muscular, glandular, etc.).

The potassium salts are eliminated chiefly by the kidneys, though the salivary, mammary and sudoriparous glands lend their aid. Kramer has found the nitrate in the feces of animals taking this salt, and infers that a portion of the potassium salts passes through the bowels unchanged.

Potassium hydroxide (caustic potash, potassa) is an active caustic, abstracting water and fat from the tissues, dissolving the albuminous elements of the parts, and when applied to the skin it produces a soft eschar which, through inflammatory action, is sooner or later separated from the untouched parts. It is a corrosive mineral poison when taken internally in concentrated form, macerating and destroying the soft parts, and causing a secondary inflammation of the larynx and esophagus which often ends in stricture and gastritis. These symptoms may be produced by liquor potassii hydroxidi, unless very largely diluted when given.

Potassium carbonate is a strong antacid in the stomach and in the blood. It favors the excretion of uric acid and with it forms salts more soluble than the sodium salts. The bicarbonate is, however, preferable for internal use, being more acceptable to the stomach. It alkalizes the urine when taken internally.

Potassium bicarbonate in small doses, taken before meals, stimulates the secretion of gastric juice and makes

the urine more acid. Larger doses impair digestion, are partly decomposed by the gastric juice, which is rendered less acid, and pass in part into the blood, increasing its alkalinity and likewise that of the urine. A vesicular eruption simulating that of eczema has been noticed as an exceptional effect of this salt.

Potassium chlorate differs from all the other salts of potassium, not only in its physiological action, but in its therapeutic effects. In small doses it is an alterative, stimulant and antiseptic. When locally applied to the mucous membranes its action is that of an irritant. It was formerly believed that potassium chlorate, when taken into the system, was decomposed and yielded up a large amount of its combined oxygen to the tissues. This was apparently proved to be erroneous by Prinz, who called attention to the fact that the salt is excreted unchanged, very largely by the salivary glands. W. E. Dixon ("Manual of Pharmacology," 3d ed., 1912), however, shows that chlorates undergo a slow reduction when in contact with putrefying organic matter, and are eliminated by the salivary glands, mucous membranes, and kidneys. He concludes that, although normal tissue fails to reduce them, the reduction is effected by septic tissue. The chlorate is, perhaps, the most poisonous salt of potassium, with the exception of the cyanide. When given in large doses it is absorbed into the blood, has a paralyzing effect on the spinal cord, and causes destructive changes (methemoglobinemia) and, if given in overdose, induces acute nephritis. One of the rare effects of the salt, when taken internally, is the production of an

erythematous, vesicular, or papular eruption. When the salt is given its effects should be closely watched. The appearance of drowsiness and scant or suppressed urine demands its immediate discontinuance. It should never be triturated with sulphur, tannin, charcoal, or glycerin, as an explosion is apt to follow.

Potassium ferrocyanide (yellow prussiate of potash) is not used as an internal medicine, except as a chemical antidote to poisoning by copper sulphate, but is used in the preparation of dilute hydrocyanic acid, cyanides, ferrocyanides and other salts. When pure, it may be taken in large amounts without producing physiological or other effects.

Potassium nitrate, in moderate doses, slows the heart action and increases the arterial tension. In large doses it exerts a paralyzing influence upon the spinal cord, and gives rise to marked muscular weakness and diminished reflexes. The movements of the heart are weakened and finally arrested. The fibrin of the blood becomes less coagulable and the oxygen-carrying power of the red blood-cells is diminished. The function of the kidneys is stimulated, as is shown by the increased quantity of urine excreted. Its irritant action on the gastrointestinal mucosa has produced death. Aubert and Dehn have shown that, with the exception of the permanganate, most of the potassium salts have the same effect on the circulation as the nitrate. Potassium nitrate is excreted unchanged.

Potassium sulphate is a powerful purgative, but is seldom used because of its irritant action.

Potassium and sodium tartrate (Rochelle salt) has the same purgative

action, but is more pleasant; in small doses it is an excellent laxative. It is an ingredient of the Seidlitz powder (*pulvis effervescens compositus*).

Potassium bitartrate (cream of tartar) is a diuretic as well as a laxative. It is an ingredient of the compound jalap powder (*pulvis jalapæ compositus*), a safe and efficient cathartic in cardiac and renal dropsy.

POISONING BY POTASSIUM AND ITS SALTS.—Potassium and its salts are rarely used for suicidal purposes. They are, however, extensively used in the arts, in the manufacture of glass and soap, under the name of potash and pearl-ash, and soap-lees, and in the form of concentrated lye for household purposes; sickness and occasionally death have occurred as the result of taking them accidentally.

POTASSIUM HYDROXIDE.—The symptoms of poisoning by potassium hydroxide or lye are an acrid, nauseating taste, followed by a burning heat in the throat and stomach, severe abdominal pains, vomiting and purging. Forty grains (1.3 Gm.) of caustic potash in solution have caused death. Death may take place within a few hours or days from laryngeal spasm or edema, shock, or cardiac paralysis, or it may be protracted several months (from inflammation of the stomach and intestines or stenotic disorders produced by cicatrization). (See ESOPHAGUS.)

The Treatment of Poisoning by Caustic Potash.—This consists in the evacuation of the stomach and administration of a vegetable acid,—acetic, citric, or tartaric,—in the form of vinegar, cider, or lemon-juice, which neutralizes the alkali and forms neutral salts. The fixed oils, which with

potash form soap, should be given. **Demulcent drinks** will soothe the congested alimentary canal; **digitalis** and **stimulants** (hypodermically) will sustain the heart, and **opium** will alleviate the pain, control the purging, and lessen the inflammatory symptoms.

POTASSIUM DICHROMATE.—The dichromate of potash is an irritant corrosive poison. The symptoms of poisoning by this substance are yellow stains about the body and clothes, restlessness, violent abdominal pain, vomiting, purging, and collapse. Death occurs from cardiac paralysis.

The treatment of poisoning by **potassium dichromate** consists in the evacuation of the stomach and bowels, the administration of **chalk**, **soapsuds**, and **milk** or **albumin**, and the use of **demulcent drinks** and **opium**.

POTASSIUM BROMIDE.—This salt occasionally causes gastralgia when taken upon an empty stomach.

Treatment of Poisoning by Potassium Bromide.—This consists of the administration of **hot drinks** and **carminatives**. (See BROMIDES.)

POTASSIUM CHLORATE.—In toxic doses potassium chlorate exerts a paralyzing effect upon the spinal cord, but has a more profound action upon the blood, disintegrating the corpuscles and making it of a chocolate color. In poisonous doses vomiting with hematemesis, delirium, hemogenous jaundice, and coma result.

The general body temperature is markedly depressed, and rigors, cyanosis, and great muscular weakness are usually present. Death occurs from the depression of the vital powers, due to its destructive action upon

the blood and the congestive obstruction of the kidneys.

In addition to the above symptoms the appearance of small, punctiform hemorrhagic spots on the legs and extending to the trunk and upper extremities has been observed as late as the sixteenth day.

Experiments showing that potassium chlorate is a strong poison for the nerve-cells, which are first excited, then paralyzed. On introducing it into the circulation it seems fair to assume that a certain amount reaches the brain in sufficient concentration to excite and paralyze, especially the respiratory center. S. J. Meltzer (Therap. Gaz., July 15, 1900).

Case of potassium chlorate poisoning after 6 Gm. (1½ drams) of this salt had been taken with suicidal intent. Hemolysis followed, with profuse hemorrhages from the digestive tract. Under **blood transfusion** conditions materially improved each time, but acute failure of the kidneys developed after the fourth transfusion in the course of a week, leading to a fatal issue. Zuccola (Policlinico, Jan. 17, 1921).

Treatment of Poisoning by Potassium Chlorate.—Two symptoms have been pointed out by F. Forchheimer as being a warning for the stoppage of this drug: drowsiness and a scantiness of suppression of the urine. Landerer advises, as the best treatment, **venesection** followed by **infusions of normal salt solution**, or, better, of **defibrinated blood**. In addition we may suggest, further, the use of **saline purgatives** and **diuretics**, especially **caffeine** and **calomel**, with **hot baths**.

POTASSIUM CYANIDE.—The symptoms and treatment of poisoning by this drug are those of hydrocyanic acid poisoning (see HYDROCYANIC ACID). The prompt administration

of **alkalies** is advised to prevent the decomposition of this salt by the gastric juice. The **stomach and intestinal canal** should be **evacuated** as soon as possible and arterial stimulants (**coffee, ammonia, caffeine**) administered. **Cold affusions** to the **spine** and **friction of the extremities** are indicated. Death has occurred from 3 grains (0.2 Gm.) of this drug. **Morphine** seems to be the antidote to the cyanide of potassium, and *vice versâ*. It is thought that, owing to the presence of the iron in the blood, which is an alkaline medium, there are formed Prussian blue and an oxide of morphine.

Acids should not be taken after the ingestion of potassium ferrocyanide, as it is decomposed even by weak acids, with the liberation of hydrocyanic acid.

POTASSIUM NITRATE.—In large doses this substance is an irritant poison. Death has occurred from 1 ounce (30 Gm.). The poisonous symptoms are intense abdominal pain, vomiting, coldness of the extremities, diminished body heat, partial paralysis, tremors, convulsions, and collapse. This drug has a paralyzing influence upon the spinal cord, which is evidenced by a great muscular weakness and diminished reflex sensibility. Death usually occurs from cardiac paralysis or from collapse due to the irritant action of the drug upon the gastrointestinal mucous membrane.

Treatment of Poisoning by Potassium Nitrate.—There is no chemical or physiological antidote. The treatment of poisoning should begin with the **evacuation of the stomach**. **Mucilaginous drinks** may be given, and **external warmth** applied to the body.

Cardiac stimulants (**amyl nitrite, caffeine, atropine**) are needed to sustain the heart.

POTASSIUM SULPHATE AND TARTRATES.—These salts in large doses act as irritant poisons, producing severe abdominal pain, vomiting, etc.

Treatment of Poisoning by Potassium Sulphate and Tartrates.—This consists in the **evacuation of the stomach** and the administration of **warm demulcent drinks** and **opium**. **Cardiac stimulants** may be needed, and **warm external applications** are usually indicated.

THERAPEUTICS.

CAUSTICS.—The caustic alkalies possess a very high diffusive power, and penetrate and destroy the tissues widely and deeply; so that certain precautions should be observed in their use lest the amount of tissue destroyed be larger than desired. When potassium hydroxide is used as a caustic, the surrounding parts should be protected by adhesive plaster in one or more layers, a central hole having been cut out through which the caustic may have access to the skin. The size of the hole should be rather less than the area to be acted upon, as the eschar is apt to be larger than the area to which the caustic has been applied. The caustic in the form of the fused potassium hydroxide is moistened slightly and rubbed firmly upon the surface until it assumes a dull-bluish look, and until the cuticle is softened and easily rubs off. The spot should then be washed with dilute vinegar, to neutralize any of the remaining alkali, and a poultice applied to facilitate the separation of the slough and to ease the pain.

Potassium hydroxide alone is often more powerful than is desired, and it is commonly combined with quicklime, in equal amounts, forming potassa cum calce (U. S. P., 1890), or Vienna paste, which must be moistened with alcohol before use.

Potassium hydroxide and Vienna paste have been extensively used to destroy **cancerous growths**, to limit **sloughing ulcers**, to remove the thickened, indurated edges of **chronic ulcers**, and to open **boils**, **carbuncles**, and **indolent or deep-seated abscesses**. They are said to prevent scarring. They have also been employed in the treatment of **warts**, **nevi**, **malignant pustules**, and **phagedena**. Caustic potash has been used by surgeons in the postoperative treatment of **fistula in ano**, to keep the cut edges apart until the deeper parts of the wound are filled with granulations.

Ingrowing toe-nail may be treated successfully by painting the offending portion of the nail with a solution of potassium hydroxide (25 to 40 per cent.). In a few seconds the upper layer of the nail will become soft enough so that it can be easily scraped off with a piece of broken glass. This operation is repeated until only a thin scale of the nail remains, which may be excised with a pair of fine scissors.

Liquor potassii hydroxidi has been used externally in the treatment of **felons**. The undiluted solution, painted on the felon every hour or two in its early stages, in many cases will abort it. Poultices containing a considerable quantity of unleached wood-ashes is used in treating felons by the laity, with good results. In a diluted form, liquor potassii hydroxidi is used in cutaneous affections charac-

terized by acid secretions and to remove crusts, etc.

Potassium dichromate, another member of this group, is used in saturated solutions for the removal of **cancerous tumors**, **rodent ulcers**, **corns**, **warts**, **venereal vegetations**, and **mucous patches**.

The author has used potassium dichromate in the treatment of **cancer**. In 20 cases he injected about 8 to 15 minims (0.5 to 1 c.c.) of a 10 per cent. solution into the tumor every other day, and obtained excellent curative results. As many as 40 injections were made in some cases. Through this treatment gangrene was induced, the tumor shrunk progressively, and complete cure was finally obtained. Although in only a few of the cured cases was the diagnosis confirmed by the microscope, his results are worthy of notice. J. Fenwick (Brit. Med. Jour., No. 2514, p. 589, 1909).

The author obtained a successful result in a case of **rodent ulcer**, from the external application of a 10 per cent. solution of potassium dichromate. W. M. Gemmill (Brit. Med. Jour., No. 2547, p. 1225, 1909).

In a 1 per cent. solution it is an astringent and deodorizer. This salt is used in the preparation of the **battery fluid** used in zinc-and-carbon batteries, and is made as follows: 6 ounces (180 Gm.) of this salt are dissolved in 3 pints (1500 c.c.) of water and 6 fluidounces (180 c.c.) of commercial sulphuric acid are very slowly added to the solution. **Müller's fluid**, used for the preservation of anatomical and pathological specimens, is composed of 3 parts of potassium dichromate and 1 part of sodium sulphate dissolved in 100 parts of water.

SYSTEMIC ANTACIDS.—The members of this group are used to

neutralize an excess of acidity, acting locally, in the alimentary canal, or through the blood upon systemic disorders due to or aggravated by the presence of undue acidity.

In **acid dyspepsia** associated with **heartburn** and **pyrosis**, large doses of potassium bicarbonate (20 to 30 grains—1.3 to 2 Gm.) will be found useful. In **acid dyspepsia with pain** or **vertigo**, Robin advises the following: Potassium bitartrate, 3 drams (12 Gm.); sublimed sulphur, $1\frac{1}{4}$ drams (5 Gm.); precipitated chalk, $\frac{1}{2}$ dram (2 Gm.); Dover's powder, 15 grains (1 Gm.); mix and divide into ten powders, one to be taken after each meal. In **atonic dyspepsia** small doses of the bicarbonate will stimulate the secretion of the gastric juice. In some cases of **gastralgia**, potassium bicarbonate in full doses, given in some effervescent water, will afford prompt relief. The **indigestion of obese persons**, especially if they are **rheumatic** or **gouty**, will be relieved by full doses of the bicarbonate given after meals, in a full glass of water or, better, carbonic acid water. The bicarbonate will not only prevent the formation of butyric acid, but will, moreover, also assist in emulsionizing the fats and in their absorption. In **acid diarrhea** potassium bicarbonate is an efficient remedy.

In **bronchitis**, especially in **rheumatic** and **gouty persons**, liquor potassii hydroxidi is a good addition to the cough-mixture. J. V. Shoemaker gives the following: Liq. potassii hydroxidi, 1 dram (4 c.c.); syrup of senega, 1 ounce (30 c.c.); compound mixture of licorice, enough to make 6 ounces (180 c.c.). Of this a dessert-spoonful, in a wineglassful of water, is given every three hours when the ex-

pectoration is tough and scanty. In **pertussis**, potassium carbonate has been found valuable, given in doses of 1 to 2 grains (0.06 to 0.13 Gm.) several times a day.

In **gonorrhea**, as the urine is rendered alkaline under its use, liquor potassii hydroxidi is frequently combined with other remedies, as in the following: Liq. potassii hydroxidi, balsam of copaiba, of each, 6 drams (24 c.c.); mucilage of acacia, 3 ounces (90 c.c.); spirit of nitrous ether, 6 drams (24 c.c.); tincture of opium, 1 dram (4 c.c.); water, enough to make 6 ounces (180 c.c.). Of this a tablespoonful, well diluted, is given three or four times a day in **acute gonorrhea**. In **cystitis** and **pyelitis** the same combination will be found serviceable. If in cystitis alkaline decomposition has set in, the use of alkaline remedies will aggravate the disorder by aiding the transformation of urea into ammonium carbonate.

In **acute rheumatism in plethoric persons** with strong, acid perspiration, treatment with the alkalies gives most satisfactory results. If the system is alkalinized early in the disease, it is generally conceded that there is less danger of cardiac complications. The bicarbonate, citrate, acetate, or sal Rochelle may be given in doses of from 20 to 30 grains (1.3 to 2 Gm.) in cinnamon-water, well diluted, every three or four hours.

In **chronic rheumatism**, potassium iodide, in 10-grain (0.6 Gm.) doses, given in compound syrup of sarsaparilla three times daily, may be supplemented by alkaline baths made by dissolving 7 to 14 ounces (215 to 430 Gm.) of potassium bicarbonate in 30 gallons (120 liters) of hot water. The bath should be taken warm.

The alkalies are of great value in the **uric acid diathesis** and in the various **cutaneous affections** said to be dependent upon it.

DIURETICS.—In **edema**, **ascites**, and other **serous effusions** the diuretic effects of this group will be of great service. Potassium acetate may be given alone in doses of $\frac{1}{4}$ to 1 dram (1 to 4 Gm.), several times a day, or in a mixture similar to the following: Potassium acetate, 4 drams (15 Gm.); infusion of pilocarpus and compound spirit of juniper, of each, 2 ounces (60 c.c.); of this a dessertspoonful, in a wineglassful of water, may be given every two hours in **edema with suppression of urine**. In **functional inactivity of the liver** acetate of potash does good.

In **alcoholic cirrhosis with ascites**, cream of tartar in a dose of $\frac{1}{2}$ to 1 ounce (15 to 30 Gm.) is an excellent hydragogic purgative.

The author reports a case of **alcoholic cirrhosis of the liver** in which he removed the ascitic fluid from the abdominal cavity, not by the usual mode of puncture, but by a diet of light food, and by giving the patient $\frac{1}{2}$ ounce (15 c.c.) of the following mixture every two hours: Decoction of marshmallow root, $\frac{1}{3}$ to 6 ounces (10 to 180 c.c.); potassium bitartrate, $\frac{1}{2}$ ounce (15 Gm.); syrup, $\frac{2}{3}$ ounce (20 c.c.). After a few days of this treatment the daily quantity of urine increased, amounting after five days to from 3 to 4 pints (1500 to 2000 c.c.). The stools became normal and the circumference of the abdomen steadily decreased. Dyspnea was relieved, and the general condition was so much improved that the patient was able to return to his work. A similar result was obtained by the author in other cases of alcoholic cirrhosis of the liver. The author insists that the use of the remedy must be prolonged for several

weeks to obtain results. The favorable action is apparently due to its diuretic properties. H. Eichhorst (Med. Klinik, No. 11, p. 381, 1909).

In **lithemia** and in **disorders of the urinary secretions** the citrate or bitartrate may be used. A good combination is: Potassium bitartrate (crystals), $\frac{1}{2}$ ounce (15 Gm.); infusion of juniper, 1 pint (500 c.c.); this amount to be taken in divided doses during the twenty-four hours. In **chronic Bright's disease** the bitartrate and acetate are valuable; also in **puerperal eclampsia**. In the **edema of heart disease** the bitartrate or acetate may be used in the form of the "Potus Imperialis": Cream of tartar, $\frac{1}{2}$ ounce (15 Gm.); water, 3 pints (1500 c.c.); sweeten, and flavor with orange-peel.

The author confirms the results of Eichhorst in reference to the use of potassium bitartrate in **ascites due to cirrhosis of the liver**. He gives 60 to 75 grains (4 to 5 Gm.) three times daily for months. He has for many years recommended the remedy in combination with digitalis in the **congestive edemas of valvular heart disease with failing compensation**. O. Burwinkel (Med. Klinik, No. 17, p. 627, 1909).

The members of this group are useful in the treatment of **uric acid calculi**. The best, perhaps, is the citrate, as it has the least tendency to derange the stomach when taken over a long period of time. We may give 5 grains (0.3 Gm.) each of the citrates of potassium and lithium in Vichy water every four hours, as it is necessary in these cases to keep the urine continuously alkaline.

Potassium citrate is a valuable remedy in those cases of **incontinence of urine** which are due to a highly concentrated condition of the urine.

PURGATIVES. — The purgative potassium salts belong to that class of purgatives generally known as saline cathartics. Their activity depends upon their power to increase intestinal secretion. Experiment has shown that the strength of the solution of a saline cathartic as it exists in the intestines within two hours after the administration of the salt is from 5 to 6 per cent. If the salt has been given in greater dilution than this, water has been absorbed from it until this strength has been reached; if in greater concentration, the tissues have yielded their fluids to dilute it to the necessary degree. It then follows that if we wish to produce serous depletion, we should administer the salines in concentration; on the other hand, if we desire prompt action they should be given in a solution of about 5 per cent. strength.

Another well-known fact is that, if for any reason the saline fails to produce purgation, absorption of the salt takes place and a marked diuretic effect will follow. This explains why the members of this group are classed with the diuretics when they are administered in small doses.

The members of this group are useful in **acute inflammations** on account of their antiphlogistic action. In **congestive** and **dropsical conditions** and **ascites** the salines given in concentrated solution are hydragogues. In **abdominal inflammations**, as **appendicitis** and **chronic peritonitis**, they are antiphlogistic and depletive. In **acute peritonitis** they are useful in cases following surgical operations, but are contraindicated by feebleness and by perforation or obstruction of the bowels. In **septic processes**, **cellu-**

litis, **infected wounds**, etc., potassium bitartrate has been used with success.

The authors state that potassium bitartrate is an efficient substitute for iodoform in the treatment of **septic processes**. They use it as a powder or as a 5 to 6 per cent. solution or suspension. It diminishes the virulence of aërobic bacteria and decomposes their toxins by instituting a process of oxidation on contact with the blood. In addition to its oxidizing action, potassium bitartrate accelerates protoplasmic and leucocytic movements; by its chemotactic properties it increases diapedesis and favors granulation in the tissues, which suits it to the treatment of **infected wounds**, **cellulitis**, **gonorrhea**, and **operation wounds**. For **syphilitic affections** Mazzini combined it with boric acid and mercury bichloride, and found its action favorable in **necrosis** and **gangrene**. In **suppurative lymphangitis** its action is very prompt, leading to the formation of a crust upon the **wound** surface, under which healing rapidly takes place. Mazzini (*Nouv. remèdes*, No. 16, 1908); Volpe (*Gaz. degli osp. e delle clin.*, No. 5, 1908).

In **serous effusions**, as **pleurisy**, the salines are given in the second stage to remove the effusion, and should be administered in concentrated solution. In **abdominal hemorrhage** they are useful as hemostatics, when given in concentrated solution, since by depletion they lower the blood-pressure. In **hemorrhages due to hepatic obstruction** they are particularly beneficial because of the depletive action on the portal circulation.

In **plethora**, if **constipation** is present, as it usually is, the daily use of salines before breakfast is to be recommended. Persons suffering from **uric acid diathesis** with **rheumatism** or **gout** should use the salines by choice when laxatives or purgatives

are needed, as they aid elimination and are antacid. A useful laxative where **hemorrhoids** are present is the following: Cream of tartar, 1 ounce (30 Gm.); washed sulphur, aromatic powder, of each, $\frac{1}{2}$ ounce (15 Gm.); one teaspoonful of this may be made into a bolus with orange-syrup, and taken once or twice a day. As an aperient, cream of tartar may be given in doses of from 1 to 2 drams (4 to 8 Gm.).

Sal Rochelle, or potassium and sodium tartrate, is an ideal saline laxative. It is most efficient when taken in the early morning when the stomach is empty, which is true of all salines. Sal Rochelle is the laxative agent in the Seidlitz powder, of which one is laxative and two are purgative.

The sulphate is a gentle cathartic, causing little pain, producing watery stools, and having some cholagogic action; it is said to act beneficially when **suppression of the milk** is desired, and is often given in **fevers** and **after delivery**, as a laxative, in doses of from 1 to 2 drams. Potassium acetate may be given as a purgative in doses of from $\frac{1}{2}$ to 2 ounces (15 to 60 Gm.).

FEBRIFUGES.—The members of this group are useful in **fevers** and **inflammations** in that they lessen heat and promote excretion of the inflammatory products. The febrifugal salts of potash lessen the blood-pressure, the temperature, and the heart's action.

In the **mild fevers**, as **measles** and **scarlet fever**, the solution of potassium citrate may be given in doses of 1 to 4 drams (4 to 15 Gm.) every two hours. If preferred, an extemporaneous solution may be prepared as

follows: Potassium carbonate, 15 grains (1 Gm.) is dissolved in $\frac{1}{2}$ ounce (15 c.c.—1 tablespoonful) of water, and this solution added to 1 ounce (30 c.c.—2 tablespoonfuls) of a mixture of equal parts of lemon-juice and water; this is given in a single dose, and should be freshly prepared each time. For convenience, a solution of the carbonate may be made up in quantity, each $\frac{1}{2}$ ounce (15 c.c.) of which contains 15 grains (1 Gm.) of the salt.

In **acute rheumatism**, potassium nitrate may be used as a febrifuge, 1 ounce (30 Gm.) of the salt being dissolved in 1 pint (500 c.c.) of barley-water or in the same quantity of syrup of gum arabic and water; a tablespoonful may be taken every three hours. In **pneumonia**, potassium nitrate may be given, with great benefit, in small doses ($\frac{1}{4}$ grain—0.015 Gm.), combined with $\frac{1}{12}$ to $\frac{1}{6}$ grain (0.005 to 0.01 Gm.) of Dover's powder every two or three hours. In **asthma** relief is generally obtained by igniting small squares of bibulous paper previously dipped in a 20 per cent. solution of potassium nitrate and dried (*charta potassii nitratis*, U. S. P., 1890), and inhaling the fumes. The **hoarseness of singers and speakers** is relieved by 2 grains (0.13 Gm.) of the nitrate dissolved in a glass of sweetened water. In **malarial intermittent fever**, the nitrate is especially valuable, if given in a single dose of from 15 to 25 grains (1 to 1.6 Gm.) in either the febrile or the non-febrile stage. The nitrate is a reliable remedy in **hemoptysis with fever**.

In **purpura simplex**, 10-grain (0.6 Gm.) doses of the nitrate are useful; in **purpura hemorrhagica** it may be given in doses of from 10 to 60 grains

(0.6 to 4 Gm.). In the treatment of **burns** of all kinds potassium nitrate has been strongly recommended by Poggi as a topical application. See SKIN, INJURIES OF, and BURNS.)

ALKALINE LOTIONS.—Alkaline lotions are used with benefit in cutaneous and other disorders. A weak solution of the bicarbonate (1 dram to 1 pint—4 Gm. to 500 c.c.) has been used as an application to **rheumatic joints**, and in **eczema** in the **early and middle stages** when there is a copious weeping from a red and raw surface. Hebra advises the application of the official liquor potassii hydroxidi or of a stronger solution, in the **chronic** forms of **eczema**. He brushes liquor potassii hydroxidi, once a day, over the surface, and, if it produces much smarting, washes the residue off with cold water. When the skin is only slightly infiltrated and thickened he employs a solution of 2 grains (0.13 Gm.) of caustic potash to 1 ounce (30 c.c.) of water; but, if the infiltration is greater, he uses a solution containing from 5 to 30 grains (0.3 to 2 Gm.) or more to the ounce (30 c.c.). These stronger applications must be employed only once a day and must be quickly washed off with cold water. This treatment speedily allays the itching, but is apt to make the skin brittle. To obviate this condition McCall Anderson applies, every night, either codliver oil or glycerin. Anderson frequently employs alkalies in conjunction with tar or oil of cade, as in the following: Equal parts of soft soap, rectified spirit, and oil of cade; a little of this to be firmly rubbed over the eruption night and morning; it should be washed off before each reapplication.

In **eczema of the vulva** Lusch ad-

vises the use of the following: Potassium bicarbonate, 1 dram (4 Gm.); sodium bicarbonate, 2 drams (8 Gm.); glycerin, 1½ drams (6 c.c.); laudanum, 2 drams (8 c.c.); water, 8 ounces (250 c.c.); this is to be used as a lotion, night and morning. In **pruritus vulvæ**, and in **bites and stings**, a solution of the bicarbonate (2 drams—8 Gm.—to 1 pint—500 c.c.—of water) will give relief. A weak solution of caustic potash or of the carbonate (1 dram—4 Gm.—to 1 pint—500 c.c.), applied with a small piece of sponge, is often of extreme comfort in **urticaria** or **lichen**. A solution of the same strength of the cyanide of potash, which has a strong alkaline reaction, is, perhaps, better. (Ringer.)

In **functional leucorrhea**, due to excessive secretion of the glands of the cervix uteri, the vaginal injection of a weak solution of the bicarbonate (1 dram—4 Gm.—to 1 pint—500 c.c.) will give relief; when the discharge is like the white of an egg or lumpy, three or four injections will often cure; but, when the discharge is yellow and puriform, these injections may fail, although in many cases, when this yellow discharge is due to a mere abrasion of the os uteri, these injections, continued for a week or two, will change the yellow to a white discharge. (Ringer.)

Potassium citrate is often serviceable as an antiemetic in doses of from ½ dram to 4 drams (2 to 15 Gm.); the official liquor potassii citratis is often preferred in doses of from 1 to 8 drams (4 to 30 c.c.).

In the **nausea and vomiting** of the first stage of **acute bronchitis** and of **febrile affections** in general, the use of the citrate in the form of “neutral mixture” (liquor potassii citratis) or

effervescent draught will allay the trouble. Effervescent draught is composed of two solutions: a solution of potassium bicarbonate, 154 grains (10 Gm.) in 2 ounces (60 c.c.) of water, and a solution of citric acid, 112 grains (7.5 Gm.) in 2 ounces (60 c.c.) of water, the dose being $\frac{1}{2}$ to 1 ounce of each solution, mixed when needed. This preparation should be freshly made, in small quantity, when wanted, as aqueous solutions of citric acid undergo decomposition.

POTASSIUM CHLORATE.—Potassium chlorate is different from all the other salts of potassium in its therapeutic effects.

Potassium chlorate in solution (1:16) is used as a detergent mouth-wash, and especially in **mercurial salivation**. The following solution is recommended for the latter use by Hare: Potassium chlorate, 48 grains (3.2 Gm.); tincture of myrrh, $\frac{1}{2}$ dram (2 c.c.); elixir of calisaya, 3 ounces (90 c.c.); of this mixture a teaspoonful may be taken every five hours, and may be used as a mouth-wash. In **membranous or ulcerative sore mouth, in children**, the same mixture or the plain solution (1:16) may be employed in smaller doses. In **aphthæ** the chlorate, finely powdered, alone or with powdered sugar, may be dusted on the patches. **Dillon's anti-septic dentifrice** contains potassium chlorate: Salol, chalk, charcoal, and powdered cinchona-bark, of each, $2\frac{1}{2}$ drams (10 Gm.); potassium chlorate, 1 ounce (30 Gm.).

In **diphtheritic and scarlatinal sore throat** the chlorate in solution (1:16) may be applied with a swab or used as a gargle, but it is not to be swallowed.

In **diphtheria** Waugh commends

the following: Potassium chlorate, 1 dram (4 Gm.); hydrochloric acid, $1\frac{1}{2}$ drams (6 c.c.); mix and add tincture of iron chloride, 2 drams (8 c.c.); water, a sufficient quantity to make 4 ounces (125 c.c.); of this a teaspoonful undiluted is given every two hours. When diluted with equal parts of water it makes an excellent gargle. Free chlorine is generated in this mixture.

In **anginose sore throat** H. C. Wood commends the following: Sumach-berries, 1 ounce (30 Gm.); potassium chlorate, $\frac{1}{2}$ ounce (15 Gm.); boiling water, 1 pint (500 c.c.); allow to simmer for a few hours, then strain, cool, and use as a gargle several times during the day. The official troches may be used, allowing the troche to dissolve slowly on the tongue, but not too freely, lest poisonous symptoms should develop.

Wohlgemuth says that potassium chlorate should not be administered on an empty stomach, and that the urine should be examined for met-hemoglobin, which should be a guide as to the dosage of the salt.

In **hay fever**, the chlorate has been found an efficient remedy.

The author has used potassium chlorate in the treatment of **hay fever (hyperesthetic rhinitis)** with results so satisfactory that he gives it first place. When the disease should appear the nose and throat are washed with a 3 per cent. solution, smoke and dust being avoided. When signs of irritation become manifest a menthol snuff is added; while for the attacks themselves he bathes the eyes with a 5 per cent. solution and insufflates the chlorate, finely powdered, into the nasal cavities; these applications are made morning and evening. W. Koster (Nederlandsch Tijdschr. v. Geneesk., No. 20, 1906).

In **inflammation of the bladder and rectum** this drug has been used in solution as an injection. In **acute rectal catarrh with mucous diarrhea and tenesmus**, H. C. Wood advises the use of a 4 per cent. solution of potassium chlorate by rectal injection; not more than 4 ounces (125 c.c.) of the solution should be used at one time, and that should be retained for twenty minutes. A cure will often result after one or two injections.

In some cases it is well to add a saturated solution of the chlorate to an equal quantity of starch-water, as the latter aids in allaying the irritation. This is also useful in **hemorrhoids**, especially if a few drops of laudanum are added.

The irritant action of the chlorate upon mucous membranes has been utilized in the treatment of **epithelioma** of the **eyelid**; daily applications of finely powdered chlorate to the tumors are suggested; in many cases the use of the knife was obviated.

In diseases of the cornea and conjunctiva the chlorate has proved efficient.

In diseases of the cornea and conjunctiva the author has found the chlorate generally useful. A case of **superficial marginal keratitis** was cured in a week by the use of a chlorate of potash lotion. In **corneal ulcer** it was used by dusting the powdered chlorate into the eye, for its antiseptic and astringent action. W. Koster (Nederlandsch Tijdschr. v. Geneesk., No. 20, 1906).

Dumontpallier used the chlorate in three cases of **tumors of the gums and of the tongue**. One patient had been operated on for **epithelioma** of the **tongue** and during convalescence a recurrent nodule appeared near the

cicatrix; applications of lunar caustic were made, but the nodule increased in size until in dimension and shape it resembled a large bean and was papillomatous in appearance. Local applications of the chlorate, in powder, were made six times daily, and $6\frac{2}{3}$ grains (0.4 Gm.) were given internally every four hours. In six weeks it was one-half the original size; three weeks later two small, painless protuberances were visible, and two months later the growth had entirely disappeared. Continuance of treatment for two or three months is advised, and absolute assurance of the functional activity of the kidneys is necessary. The condition of the teeth as a cause of irritation should be ascertained.

Potassium chlorate has been employed with more or less success in cutaneous disorders attended with suppuration. It has been found beneficial in the suppurative stage of **sycosis**, in **pustular acne**, in **eczema pustulosa**, and in the treatment of **furuncles** and **carbuncles**. Externally the chlorate has been found useful in powder or in saturated solution, as an application to unhealthy **ulcers**.

POTASSIUM CYANIDE.—Potassium cyanide has been used externally in solution (1 dram to 1 pint—4 Gm. to 500 c.c.) to allay **paresthesia**, and as an application to the head to relieve **reflex headache**.

It is used internally ($\frac{1}{16}$ to $\frac{1}{4}$ grain—0.004 to 0.015 Gm.) in mixtures to relieve **cough**, the effect being similar to that of hydrocyanic acid.

In **nervous dyspepsia**, J. P. C. Griffith combines potassium cyanide with extract of valerian, given after each meal.

NON-OFFICIAL POTASSIUM SALTS.—*Potassium Aurocyanide*.—

Potassium aurocyanide occurs in white crystals which are soluble in water. When injected hypodermically it is rapidly absorbed and does not precipitate albumin.

Behring's researches have shown that 1 part of this salt in 25,000 parts of blood-serum rendered the latter unsuitable as a medium for the growth of the **anthrax** bacillus.

Potassium Mercurocyanide.—The allied mercurocyanide effects the same in a dilution of 1:60,000.

Potassium-mercuric Iodide.—This double salt is formed by dissolving red mercuric iodide with twice its weight or more of potassium iodide in alcohol or water. It occurs as sulphur-yellow crystals, deliquescent in moist air, and soluble in water. Although used as an alkaloidal reagent, its medicinal uses are varied and important.

The formula of a 1 per cent. solution of mercuric iodide in potassium iodide as used by the author is: Mercuric iodide, 15 grains (1 Gm.); potassium iodide, 1 dram (4 Gm.); distilled water, 3½ ounces (100 c.c.). This solution may be kept for months without change. The liquid is clear, of metallic taste, and irritating to the mucous membranes. If the local irritant effect is overcome by dilution, comparatively large amounts may be taken internally without producing severe symptoms. On a number of cases in which the drug was pushed, from 5 to 7 drops of a 1 per cent. solution was the limit of toleration, while from 15 to 18 drops of the same solution could be borne if well diluted.

Taken internally, the compound seems to have a marked effect on all catarrhal conditions of the mucous membranes, clearing up the common **cold (acute rhinitis)**, ap-

parently shortening the course of **croup**, and modifying **acute infections** of the **nose, throat** and **bronchi**. This conclusion was reached after careful observation and repeated trial. Nearly all patients with catarrhal conditions remarked that it gave them great benefit in freeing the sticky mucus. This was particularly true in **acute bronchitis**. In cases of **gastritis** and **enteritis** exhibiting much mucus the same effect was noted. The drug further acts as a mild stomachic if used in a careful dose.

Locally a beneficial effect was often noted in **atrophic rhinitis**. In a number of cases of **acute frontal sinusitis** marked relief was noted because of the free rhinorrhea set up. The free outpouring of thin mucus sweeps before it the thick secretions that have accumulated in the blind cavities. In **syphilis, psoriasis, cryptogenic infections** of the **skin**, and **lupus**, the French have long been partial to potassium-mercuric iodide, using it both internally and as an ointment.

It is as an antiseptic, however, that the field for this compound is greatest, for in great dilutions its local effects and toxicity are insignificant, while its germicidal qualities remain high. A 1 per cent. solution has but slight irritant action, while a dilution of 1:80,000 or nearly one one-thousandth of 1 per cent. exhibits marked germicidal powers.

Cases of **erysipelas, acne, pustular infections** of the **skin** of all varieties show remarkable results under its use. The purulent discharge in minor surgical cases, such as **infected burns, old leg ulcers, and ragged wounds**, is rapidly cleared up. Even when the affection is somewhat subcutaneous, as in **felons and boils**, when there is as yet no pointing or definite formation of pus, a wet dressing of 1 per cent. potassium-mercuric iodide will usually reduce the case and frequently abort it altogether.

For the **sterilization of instruments** the drug is excellent, except for its tendency to tarnish if left in contact

too long. This can be easily overcome by the addition of a little sodium bicarbonate. Douglas Macfarlan (Jour. Amer. Med. Assoc., Jan. 3, 1914).

Potassium Cantharidate.—This substance occurs as a white, amorphous powder or in crystalline mass which is soluble in water. It has been used by Liebreich hypodermically in very attenuated solutions in the treatment of **tuberculosis**.

Potassium Cobaltonitrite.—This salt occurs in yellow, microscopic crystals, which are slightly soluble in cold water and insoluble in alcohol and ether. It is used where the nitrites are indicated (**dyspepsia**, **cardiac albuminuria**, etc.), and is claimed to be more easily regulated in its physiological action than most nitrites. It is given in doses of $\frac{1}{2}$ grain (0.03 Gm.) every two to four hours.

Potassium Dithiocarbonate.—This salt results from the action of carbon disulphide on potash-lye at boiling temperature. It occurs in an orange-red, deliquescent, crystalline powder, which is very soluble in water and slightly soluble in alcohol. It is used in a 5 to 10 per cent. ointment in the treatment of **eczema**, **tinea tonsurans**, and other cutaneous disorders. In a 20 per cent. ointment it is used in **psoriasis**.

Potassium Osmate.—Potassium osmate, or perosmate, occurs in a violet-red, crystalline powder, soluble in water. It is used in the dose of $\frac{1}{60}$ to $\frac{1}{4}$ grain (0.001 to 0.015 Gm.) in combination with the bromides against **epilepsy**, and hypodermically in **neuralgia**, **goiter**, etc., like perosmic acid.

Potassium Sozoiodolate.—Potassium sozoiodolate (or potassium diiodopara-

phenolsulphonate) occurs as a glittering, white, crystalline powder, having a slightly sour taste, soluble in hot water, and slightly soluble in cold water (1 to 70). It contains 52.8 per cent. iodine, 20 per cent. phenol, and 7 per cent. sulphur. It is antiseptic and bactericidal in its action. It is incompatible with mineral acids, ferric chloride, silver salts, etc. Strong sulphuric acid or heat drives off iodine vapor. It is a substitute for iodoform. It is non-toxic, odorless, and soluble. Even when applied pure it does not irritate the skin; when the skin is inflamed it leads to a mild and reactionless exfoliation. It acts as a desiccant in powder or salve in concentration of from 1:10 to pure.

It is used externally in **scabies**, **eczema**, **erysipelas**, **herpes tonsurans**, **impetigo**, **syphilitic ulcers**, **diphtheria**, **burns** and **scalds**, **ozena**, **otitis** and **rhinitis**, and as an injection in **gonorrhea**. A $2\frac{1}{2}$ per cent. solution is sufficiently strong to kill *Acarus scabiei* in twenty-five minutes.

Potassium Tellurate.—This salt occurs in white crystals, soluble in water. It was introduced by Neusser, and is used in doses of $\frac{1}{2}$ to $\frac{3}{4}$ grain (0.03 to 0.045 Gm.) in pill or alcoholic julep in the treatment of the **night-sweats of phthisis**. After one week it may be necessary to double the dose. No toxic symptoms follow its use. The appetite improves. During its administration the breath has a garlicky odor. This salt suppresses or diminishes the sweats, but does not influence the course of the disease.

C. SUMNER WITHERSTINE,
Philadelphia.

POTT'S DISEASE. See SPINE, DISEASES OF.

PRAIRIE ITCH.—Prairie itch is a name given to various skin affections, marked by pruritus, and seen among farmers, lumbermen, etc. It is probably due to a lack of cleanliness and the irritation of coarse underclothing.

TREATMENT.—Personal hygiene is of first importance in this disease. Warm cleansing baths should be taken at regular intervals. Woolen undergarments should not be worn, but if weather conditions make them necessary, a thin cotton gauze, silk, or linen garment should be worn next to the skin. Local measures give considerable relief, lotions being preferred when the itching is more or less generalized. Cider vinegar is a grateful application. Phenol, menthol and camphor, thymol, and witchhazel extract have been found useful. W.

PREGNANCY AND PARTURITION.

A. PREGNANCY.

DIAGNOSIS OF PREGNANCY.

—The vagina and cervix develop a succulent condition, with increased secretion, in the early weeks of pregnancy. There also often appears very early, especially in multiparæ, a slight bluish discoloration of the vaginal wall, which is most marked on the urethral prominence. The structure which is the very earliest to show the bluish discoloration, however, is the cervix; but the diagnostic value of discoloration at this point is reduced by the fact that it frequently appears also before menstruation. Later, in the third and fourth months of pregnancy, a very typical and rather pathognomonic dark blue color is visible at the introitus vaginæ.

Up to the twentieth week or during the first half of pregnancy, the diagnosis of the condition rests principally upon an enlarged uterus with a cessation of the menstrual flow. In

nearly all other conditions causing enlargement of the uterus there is either excessive loss of blood or, at least, no interruption of the menstrual cycle. In hematometra there is menstrual suppression but it is only apparent, the blood being retained within the uterus. In pyometra the menses are suppressed because the uterine surface from which the flow should come suffers from inflammatory destruction.

Certain minor signs of pregnancy which, while taken singly are not infallible, when all are present are strong presumptive evidence. These are: morning sickness, which is also characteristic of acute alcoholism; changes in the breast, not infrequently seen with uterine myomata, ovarian cysts, spurious pregnancy, and other rarer conditions, and both these signs may be absent though pregnancy exists; softening of the cervix may be the result of inflammation and the blue coloration of the vagina, while often not seen in pregnancy, is not infrequently observed with impacted pelvic tumors.

“Hegar’s sign,” consisting of the bimanual palpation of soft, edematous, anterior and posterior walls of the lower uterine segment, contrasting with the firmness of the fundus and cervix above and below, is not to be relied on alone, but combined with other symptoms is presumptive evidence.

The writer emphasizes a diagnostic sign for early pregnancy consisting of a circular area situated in the median line of the anterior surface of the body of the uterus, just above the junction of body and cervix. It varies in size according to the duration of pregnancy, and offers to the palpating finger the distinct sensa-

tion of elastic fluctuation. It can frequently be made out as early as the fifth week, when the area is only the size of a finger-tip; but it can always be felt in the sixth week, when it is somewhat larger. As pregnancy advances this area increases in size in a crescentic manner and extends upward toward the fundus until the third month of pregnancy, when nearly the entire anterior body of the uterus presents the phenomenon. L. J. Ladinski (*Amer. Jour. of Obstet.*, Aug., 1913).

The writer considers it evidence of pregnancy if the palpating finger in the vagina meets the center of the cervix on the axial line of the canal. This shows that instead of the uterus being in normal ante flexion, it lies in a line with the axis of the vagina, with tendency to slide down into the latter. This indicates that the uterus is heavier than normal. The uterus is rendered heavy by the menstrual congestion preceding the onset of the menses, or else from the embedding of an ovum. If the menstrual discharge does not follow within a few days, the presumption of incipient pregnancy is justified. Dezwarte (*Paris méd.*, Feb. 12, 1921).

"Quickening" as it depends upon the patient's statement is, in primiparæ, of little value, in multiparæ it is more significant; the uterine souffle indicates, at least, that the tumor is uterine, and is best heard over the broad ligament, but is present with a vascular myomatous uterus and exceptionally over a uterus drawn upward by a large ovarian cyst, and may be absent in case of pregnancy or present one day and absent another. While these minor signs are more or less confirmatory, the diagnosis cannot be settled by their presence or absence when the presence of an enlarged uterus with cessation of the menses is either ab-

sent or doubtful. Very often the thyroid gland is moderately enlarged in early pregnancy.

The ease with which uterine enlargement may be made out will depend upon the age of the pregnancy, the presence or absence of much fat in the abdominal walls, and the position and consistency of the uterus. After the first month an increased size of the uterus, if it can be made out, is pathognomonic of pregnancy. At three months it has ascended sufficiently to be palpated, except in very stout patients. The pregnant uterus in the early months is soft in consistency; percussion will reveal an area of dullness over the center of the lower abdomen. During the first month the uterus descends into the pelvis and the cervix is more easily reached.

The results obtained from the Abderhalden test in pregnancy have proven so unreliable that the procedure has been largely abandoned as a practical diagnostic measure. (For the technique see *ABDERHALDEN TEST IN PREGNANCY*, vol. v, p. 389.)

The writer, having applied the dialyzation test to 100 cases, 36 of which were pregnant, concludes that, having made all possible allowances, the percentage of glaring mistakes is sufficient to destroy its diagnostic worth. Archibald Leitch (*Brit. Med. Jour.*, July 25, 1914).

The X-rays have been of material assistance in the diagnosis of pregnancy, being available at least as early as the third month.

At the beginning of the third month of pregnancy, and sometimes before, it is possible to obtain sufficiently satisfactory X-ray pictures of the fetus. In the later months, pregnancy can

be diagnosticated without difficulty. The diagnosis of multiple pregnancy can be made thus in the first half of pregnancy and abnormal positions, as well as probably hydrocephalus and certain malformations, made out. Extra-uterine pregnancies give as good pictures of the fetus as the normal, but the differential diagnosis depends chiefly on its asymmetrical position in the pelvis (Edling).

Chief among the factors complicating the X-ray diagnosis of pregnancy are the thickness of the maternal tissues, the relatively slight density of the fetal bones early in pregnancy, the blood in the uterine walls (which has been estimated to absorb 60 per cent. of the rays), the amniotic fluid, the respiratory movements of the mother, the movements of the fetus, and the unequal distances of different parts of the maternal pelvis and the fetus from the plate.

The technique used in the author's cases consisted of an exposure of from 4 to 6 seconds with a 5-in. spark gap and the use of 25 milliamperes, a diaphragm, and a cone. Most patients were placed in the prone position, and in every instance the central ray was directed parallel with the pelvic axis. During the third and fourth months no positive roentgenograms were obtained; during the fifth month, positive results were obtained in one-third of the cases; and during the sixth month in one-half of the cases. The earliest positive result was obtained at the end of 4½ months. From these results it would seem apparent that the roentgen ray may be of value in the diagnosis of pregnancy at practically the same stage that the other three positive evidences are obtainable: viz., (1) the fetal heart sounds, (2) palpation of the fetus, and (3) the fetal movements. However, in the second trimester of pregnancy its diagnostic value is limited by the fact that a

negative result does not necessarily mean that the patient is not pregnant.

A positive diagnosis may be obtained very exceptionally toward the last of the fourth month. During the seventh, eighth, and ninth months a positive diagnosis should be obtained in the great majority of cases. Bartholomew, Sale and Calloway (Jour. Amer. Med. Assoc., Apr. 2, 1921).

During the last half of pregnancy, from the fifth lunar month to the termination, the diagnosis rests upon the signs showing the presence of a fetus—the detection of fetal parts and movements, the fetal heart sounds, and the funic souffle. Besides, we have as additional signs the rhythmic contractions of the uterus and the shortening of the cervix which takes place during the last few weeks of pregnancy.

By abdominal palpation the fundus can usually be felt above the symphysis, and by the sixth month the position of the fetus may be outlined.

At seven months fetal movements can be detected and the fetal heart sounds heard; these are the basis of positive diagnosis; prior to this the diagnosis can only be probable. In exceptional cases the fetal heart sounds may be heard as early as the end of the fourth month, usually not earlier than the end of the fifth. Fetal movements are of two kinds, a sharp knock or rebound and a slower vermicular movement. The latter might be confounded with *intestinal peristalsis*; the former can be heard with a stethoscope.

A large *ovarian cyst* may be confounded with pregnancy in the later months, but there is an absence of fetal signs and the uterus of normal size may often be detected apart

from the swelling; if the latter cannot be made out, dependence must be placed on the menstrual history and the absence of fetal signs. From *ascites* pregnancy is usually differentiated, for the areas of dullness usually differ, except when the fluid is encysted and the dullness in the flanks and resonance in front may be absent. *Obesity* and flatulent distention attended by amenorrhea may be confounded with pregnancy; the aortic impulse transmitted through the uterus would aid in the differentiation. *Myomata* of sufficient size to be confounded with late pregnancy are never accompanied by amenorrhea.

ETIOLOGY OF DISTURBANCES DURING PREGNANCY.—

These may be inherent in the woman at the inception of pregnancy; they may be due to pregnancy, or they may be the result of pregnancy *plus* other causes to which the woman may have contributed or which may be regarded in the light of accidents.

The following able classification and the definition of each condition, by A. F. Currier, are submitted:—

I. Causes which are present when pregnancy is instituted.

1. Faults of structure.

(a) Structurally defective pelvis.

(b) Defective uterus.

(c) Tumors in various parts of the body, especially in the pelvis or abdomen.

2. Faults of nutrition.

(a) Badly nourished uterus.

(b) Local disease in any organ, or any disease which seriously modifies the general condition.

II. Causes which are due to pregnancy, the patient being apparently in normal condition at its inception.

1. Mechanical influences.

(a) Pressure of the enlarged or displaced uterus upon contiguous structures.

(b) Disturbed circulation either from immediate pressure upon vascular structures or arrests of the current in its ordinary channel.

(c) Pressure upon the uterus by a new growth which has developed coincidentally with pregnancy.

2. Nervous reflexes, usually irritative in character.

3. Nutritive changes especially in the blood, nervous system, digestive apparatus, or secretions.

III. Causes which are due to pregnancy *plus* additional provocation from within or without the individual.

1. Improper diet or habits.

2. Trauma.

3. Nervous and mental irritants.

4. Intercurrent disease.

5. Irritating conditions within the ovum.

I. **Causes which are Present when Pregnancy is Instituted.**—Of the causes of disorder in pregnancy which are present at the inception of the pregnant state there are, as before stated:—

1. **FAULTS OF STRUCTURE.**—(a) Structurally defective pelvis. This may consist in the various deformities—pelvis too large, pelvis too small, or pelvis of irregular contour—which interfere with the proper and symmetrical development and enlargement of the uterus and the ovum which it contains.

This interference in the development of the uterus may lead to abortion; may produce pain, nausea, and vomiting; faults of digestion, constipation, interference with the pelvic

circulation, and a variety of distressing phenomena during pregnancy, as well as difficulty during parturition. The pelvis may also be the seat of serious disease (*e.g.*, osteomalacia), weakening its structure and rendering it unfit as a support for the body and incidentally for the pregnant uterus.

(*b*) Defective uterus. This may consist in a faulty position or in imperfections of structure which may properly be attributed to bad nutrition. The displaced uterus—whether the displacement be anterior, lateral, or posterior—is certainly a defective uterus for any purpose and in any situation, and it becomes the more strikingly so when it has been impregnated. Normal development is hindered, the circulation becomes impaired, pain and discomfort give annoyance, and unless the displacement is corrected uterine contractions may be provoked and the contents of the uterus expelled. Correction may be and often is spontaneous, but is not always a result, especially if the displacement is a posterior one. The diagnosis is almost always susceptible of determination by means of a careful bimanual examination, and successful treatment is usually possible unless the uterus is fixed by adhesions in its faulty position.

(*c*) Tumors in various parts of the body, especially in the pelvis or abdomen. A tumor in any part of the body, especially if of a malignant character, may so impair the general condition as to militate against the successful continuance of pregnancy. This is notably the case, in addition to malignant disease, with the tumors which develop in connection with tuberculosis, syphilis, and other con-

stitutional diseases. With the tumors of the pelvis and abdomen, whatever their character, it is easy to see that, by their very presence, by their encroachment upon the space required by the uterus as it enlarges, they may be an efficient cause of pain, of disturbance in the circulation, of digestive disorders, etc., and if they do not compel the uterus to throw off its contents they may so complicate the situation that parturition will become not only difficult but positively dangerous. Indeed, successful delivery by the ordinary method and measures may be quite impossible, and removal of the tumor may be required before the uterine contents can be removed.

2. FAULTS OF NUTRITION.—(*a*) Badly nourished uterus. The uterus which thus becomes a source of disturbance during pregnancy may be congenitally defective, or its defects may be the result of disease, bad habits, or traumatism. The entire organ may be rudimentary and poorly developed, or the difficulty may be limited to the muscular structure or to the endometrium. Arrest of development during fetal life from causes which are not always traceable is not particularly rare. Arrest of development from the diseases common to childhood or from constitutional disease (syphilis, tuberculosis, etc.) is also not infrequent. Traumatism, as from rape, from the forcible thrusting of sticks or other hard substances into the vagina, from burns, and from caustic substance is of less frequent occurrence.

In any of these cases pregnancy comes to an organ badly prepared to perform its function, and it does not respond to the demands which are

made upon it. We should not be surprised that pain and discomfort accompany such a pregnancy, and that its termination should be an abortion in the early months.

Another class of cases is that in which the uterus is defective from growths within its structure, especially fibroid growths. Whether these are located within the muscular structure, upon the peritoneum, or within the uterine canal, they are always a menace to pregnancy, and frequently are an efficient cause in producing its premature termination. While the disorders which attend this class of cases consist principally in disturbance which affects chiefly the uterus itself and its immediate surroundings, it not infrequently happens that systemic infection is added, and the final result may be a disastrous one for the patient.

(b) Local disease in any organ, or any disease which seriously modifies the general condition. Aside from disease in the uterus itself antedating pregnancy, there may be disease in the tubes or ovaries or both which may give rise to much trouble. Simple inflammatory conditions of these organs or distinctly infectious disease, acute or subacute, may excite much discomfort and perhaps lead to serious results.

The writer found in literature 93 recorded cases of salpingo-ovaritis complicating pregnancy, and believes that many such cases are overlooked, having himself encountered 12 such cases. Old salpingitis and ovaritis may not prevent conception, and if long extinct may not give trouble during pregnancy. But sometimes they are responsible for adhesions, pains, displacement of the uterus, torsion of the tubes or extra-uterine pregnancy. They may entail septic

trouble, early in pregnancy in about 31 per cent. of the cases; in the others usually not until the close of the pregnancy or in the puerperium. Abortion and delivery are peculiarly liable to awaken infection. Treatment can be only surgical. In the 44 cases tabulated, 86 per cent. of the women were saved by the operation; in a parallel series without operation only 38 per cent. survived. Brindeau (*Arch. mens. d'Obstét. et de Gynécol.*, Jan.-March, 1917).

Disease of the liver, kidneys, heart, or lungs may antedate pregnancy and may suffer exacerbation as pregnancy advances.

Valvular *heart lesions* in the pregnant state are considered by Guerard to constitute a serious complication, he having observed a mortality of 28 per cent.; they are regarded by him even more alarming than eclampsia or placenta previa. The mortality has been even higher among cases reported by some other authors. Williams, however, considers that these figures give an exaggerated idea of the seriousness of the condition, since they apply only to those cases in which compensation has long since failed and renal changes and toxemias exist. Jaschke, conversely, reports a mortality of only 0.39 per cent. among 1225 cases, and considers the danger overestimated.

Apparently functional murmurs are frequently heard in pregnancy, while serious organic lesions are only occasionally observed. Cases of broken compensation may result in such urgent symptoms as to demand induction of abortion or premature labor.

The presence of mitral stenosis was considered by Luck to be sufficiently serious to warrant the termination of the pregnancy as soon as diagnosis is made. A large number

of cases observed by French and Hicks, however, have led them to conclude that it is no more serious than other lesions.

Generally speaking, the prognosis is good as long as compensation is retained. Grave heart lesions complicating pregnancy, however, predispose to premature labor, and collapse may manifest itself immediately after expulsion of the child.

Myocarditis and endocarditis must also be considered as serious complications of pregnancy, the former frequently giving rise to sudden death.

Hematuria is rarely observed during pregnancy, but if blood should appear in the urine more or less serious lesions of the urinary tract should be suspected.

Pyelitis may appear in the latter half of pregnancy in patients who, having previously been perfectly well, or complained of slight vesical irritation, are suddenly seized with intense paroxysmal pains, usually in the right renal region, with high temperature and occasionally chills. Palpation shows an enlarged kidney. After a certain time a large amount of purulent urine is suddenly passed, the kidney becomes smaller, and the pain disappears. The symptoms reappear, however, as the kidney fills again. Unless treatment is carried out, septic infection may take place and terminate fatally. The diagnosis is usually clear, but yet may be mistaken for appendicitis, typhoid fever, or salpingitis.

In the attenuated form of pyelonephritis, slight albuminuria is the only symptom. It calls for relative rest, dieting and castor oil. The febrile form usually subsides in a week or 2 and the renal pain disappears under copious drinking, pur-

gatives, and urinary antiseptics. When the fever persists, indicating retention, if the kidney is not enlarged, the writer injects into the bladder a tepid solution of boric acid, to be retained as long as possible, repeating this 3 times a day. This sometimes rouses the ureters to contract and evacuate the purulent urine. If not, one should not wait too long before catheterizing the ureter. If this is not practicable, evacuation of the uterus may restore clinically normal conditions. Otherwise, one should operate on the kidney. This applies also when the kidney is much enlarged. Couvelaire (*Médecine*, Apr., 1920).

In the treatment of pyelitis, drainage is the most important factor, but the method to be used varies with the case. In some the giving of large amounts of hexamethylenamine water is sufficient to overcome the obstruction, particularly if a posture is found which will relieve the latter. Many cases respond to pelvic lavage with drainage by means of a pelvic catheter. In some cases one is faced with the necessity of a nephrostomy, induced abortion or premature labor. G. Baughman (*Amer. Jour. Obstet. and Gynec.*, Feb., 1921).

Nephritic toxemia may be observed in women in whom chronic nephritis existed prior to pregnancy, or where an acute process originates during that period. It occurs only infrequently, but should be feared in women suffering from chronic nephritis. It may appear at any period of pregnancy, but more generally in the later months. The symptoms usually present are: lassitude, general malaise, headache, and marked edema; sometimes ocular disturbances with albuminuric retinitis may be observed. In other cases, edema may be the only symptom evident, with the exception of the urinary changes, and the patient may suddenly become

comatose, with accompanying convulsions and either die or slowly recover. With the exception of syphilis, Williams considers chronic nephritis the most common cause of spontaneous premature labor.

The prognosis is good so far as the immediate life of the mother is concerned, but, ultimately, the strain of pregnancy usually aggravates the original nephritis process.

The disorder may be sufficient to provoke abortion, or the patient may go to term. Death during parturition is not uncommon.

A typical pregnancy glomerular nephrosis is not likely to develop into chronic nephritis, yet an acute exacerbation of a previously existing glomerular nephritis during pregnancy may become chronic. In ordinary cases of pregnancy glomerular nephrosis, so long as there is no tendency to eclampsia interruption of the pregnancy is rarely indicated, but with acute and chronic glomerular nephritis, such interruption must always be considered. In acute glomerular nephritis, if the blood content of the urine increases in spite of treatment or if it remains high, interruption of pregnancy is imperative. T. Heynemann (Zentralbl. f. Gynäk., May 1, 1920).

General disorders at the inception of pregnancy may also prove very troublesome,—syphilis, tuberculosis, profound anemia, or any wasting or intensely infectious disease which in itself initiates profound asthenia. Pregnancy is often interrupted under such conditions. If it should continue to term the child may be dead at birth or so poorly nourished that death may occur without a very prolonged struggle.

While the occurrence of pregnancy in the *tuberculous* exerts a harmful in-

fluence on the progress of the disease, the latter, however, does not predispose to its premature interruption and in some cases birth has been given to large and well-developed children.

The influence of *syphilis* upon pregnancy differs considerably according to whether infection takes place before pregnancy, at the time of conception, or during pregnancy. In the former case abortion or premature labor usually takes place. In premature labor the child is generally born dead; less frequently it may be born alive with definite manifestations of the disease. The child is always syphilitic when infection has taken place at the time of conception. Its effect upon the fetus varies, however, when syphilis is contracted during pregnancy, signs of the disease being evident when infection occurs during the early months, while the fetus may escape infection if it occurs later.

Resuming the description of process as given by Currier:—

II. Causes which are Due to the Existence of Pregnancy, the Patient being Apparently in Normal Condition at its Inception.

1. MECHANICAL INFLUENCES.—

These are among the most common of the causes which disturb pregnancy. They are usually traceable without great difficulty, and in some cases are susceptible of removal. In the greater number of cases, however, they persist as long as pregnancy persists.

(a) Pressure of the enlarged or displaced uterus upon contiguous structures. The conditions relating to the displaced uterus have been described. It is not until after the first half of pregnancy, as a rule, that the pres-

sure of the uterus causes disturbance. One of the most common results of such pressure is disorder in the urinary function. Without discussing the various theories concerning the albuminuria of pregnancy, it is quite evident that pressure is one of the causes, for the albuminuria usually ceases when pregnancy is terminated. When one realizes the susceptibility of the kidneys to floating and wandering, it is not strange that they should occasionally get in the way of the enlarging uterus, even when it is progressing in a perfectly normal manner.

Pressure of the enlarged uterus is also responsible for various other disorders. Pressure upon the intestines may cause obstruction in those viscera, and it often happens that the constipation which may be so troublesome during pregnancy is traceable to such a cause, especially when the pressure is directed upon the rectum.

Pressure upon the stomach may cause more or less of the indigestion and gastric discomfort of the later months of pregnancy.

Pressure upon the liver, the gall-bladder, or the bile-ducts may account for jaundice, for nausea, and vomiting. Pressure upon the diaphragm causes some of the discomfort of the latter part of pregnancy, the difficulty in respiration, and sometimes the irregularity of action which is manifested by the heart.

Pressure upon the bladder gives rise to much discomfort in not a few cases. The uterus may so rest upon this viscus that it cannot distend symmetrically as the urine enters it. This may cause such a condition of irritability that there will be a con-

stant desire to micturate. Inability to empty the bladder completely often leads to decomposition of the residual urine, with resulting cystitis, which may persist long after pregnancy has ended. Disorders of the bladder are among the most annoying troubles from which pregnant women suffer. The results of the pressure of the enlarged uterus upon nerves and ganglia are not often sufficiently pronounced to excite attention. It is, of course, possible that the sacral nerves and the ganglia of the pelvis may be so encroached upon as to cause numbness or even paralysis of the lower extremities, on the one hand, and interference with the nutrition of the pelvic and abdominal viscera, on the other. The former condition has been observed by most obstetricians of experience in more or fewer cases.

(b) Disturbed circulation, either from immediate pressure upon vascular structures or arrest of the current in its ordinary channel.

The two primary conditions which may result from this factor are anemia and congestion. Anemia is experienced, of course, in the tissues which are immediately compressed. Such a result is usually transient, since the uterus does not normally exert its pressure over the same area for a long time. It must change its position and the direction of pressure as it enlarges and emerges from the narrow limits of the pelvis to the less restricted abdomen. If, however, it becomes agglutinated to any of the structures with which it is brought in contact, that structure may suffer, not only with anemia, but with the more serious effects of malnutrition which follow as a conse-

quence. Anemia of the compressed portion is not, of necessity, attended with congestion of the contiguous portions, for the anastomosing circulation may be so perfect that the blood-current will adapt itself to the new and changed conditions. Such a fortunate result does not always occur; hence the frequent manifestation of congestions in various parts of the body in response to the obstruction which has been placed in the customary channel for the blood.

The veins of the vulva and legs furnish the most vivid illustrations of these obstructive conditions. They are frequently enlarged to an enormous size, and their rupture, especially those of the vulva, during parturition may be attended with the most serious consequences.

(c) **Pressure** upon the uterus by a new growth which has developed coincidently with pregnancy. This complication is, of course, an unusual one. Pregnancy may incite abnormal activity in growths which were previously quiescent or not troublesome, or the first intimation of their presence may come with the obstruction which they cause during pregnancy. Ovarian cysts and fibroid tumors of the uterus furnish familiar examples of this form of obstruction. Less frequently seen are bony tumors of the pelvis, malignant growths of the pelvis and abdomen, and ascites, with tuberculosis and with disease of the liver, spleen, and kidneys.

2. **NERVOUS REFLEXES.**—It would be difficult to refer to all the possible disorders of this character. The nerve-connections of the uterus with other parts of the body, especially with the abdominal viscera, are so numerous that there is a certain de-

gree of reasonableness in attributing a great variety of nervous disturbances to a cause within the uterus. A woman with highly developed nervous system may be peculiarly sensitive to irritation when the uterus is in an exalted state of functional activity, and thus we may explain many of the peculiar phenomena of pregnancy. Perhaps the most common of these phenomena are the nausea and vomiting: the "morning sickness" of pregnancy. Others which are less noteworthy are neuralgias in various parts of the body, peculiar conditions of the special senses, disturbances of digestion, secretion, etc. The nexus between these conditions and pregnancy seems to be demonstrated in the fact that with the termination of pregnancy the conditions in question disappear also.

3. **NUTRITIVE CHANGES**, especially in the blood, nervous system, digestive apparatus, and secretions. Pregnancy is certainly the expression of a physiological requirement in animal nature. Normally it should be attended by no unusual phenomena; but unfortunately the absolutely normal type of pregnancy is seldom seen. The variations in connection with the nutritive functions are especially pronounced. In a general way it may be said that exaltation is the characteristic in one class of cases and depression in another.

With the former the improved condition of the tissues shows the comparative gain in volume and nutritive value of the blood; the mind and nervous system, which may have been in a condition of irritation, are now so calm and equable that the change becomes noteworthy to those

who are familiar with the state of affairs prior to impregnation. The digestion is improved, the secretions by their abundance show the activity of the entire glandular apparatus; in a word, pregnancy has acted as a stimulant and tonic, and such women frequently declare that they have never felt better in their lives than when pregnant. This is the exaltation which may be coincident with pregnancy. In the other class the very opposite is seen: anemia becomes more and more marked as pregnancy advances, nervous and mental irritability and depression are more or less constant, melancholia and mania being not infrequent; digestion is constantly disturbed, nothing seems to be well assimilated, nausea and vomiting cause great annoyance, and the secretions are deficient in quantity and impaired in effectiveness. This is the depression which may also be the accompaniment of pregnancy.

III. Causes which are due to Pregnancy plus Additional Provocation from within or without the Individual.

1. IMPROPER DIET OR HABITS.—There are few subjects about which even intelligent people err more grievously than as to their diet and their ordinary habits. The selection of suitable food is at all times a subject of the first importance, and when those who suffer with the ills of pregnancy suffer also from the use of improper food, whether this be the result of necessity, or of ignorance, or of willfulness, the consequences are pitiable, for nature is no respecter of persons. The sufferings in these cases are primarily, of course, related to the digestive apparatus, indiges-

tion, constipation, nausea and vomiting, and loss of appetite being most conspicuous; but other portions of the economy may become involved, until confusion and anarchy prevail. Among other unfavorable influences are overwork, insufficient sleep, the excitement of life in society, alcoholic excesses, and frequent coitus.

During the recent war it was noticed that underfed women bore large children, but the writer urges that fasting and dieting are quite different. He recently employed his regimen in a gravida who had previously borne a 3500-Gm. infant and the child weighed but 2600 Gm. Prochownick (*Zentralbl. f. Gynäkol.; Med. Rec.*, Apr. 27, 1918).

The writer deems especially valuable in pregnancy the earthy salts and fruit acids contained in **vegetables** and **fruits**. Fruits and fruit pulp and fruit acids are the best possible laxatives for a pregnant patient. Where indigestion is annoying and persistent, especially valuable is the **juice of the fresh lime** or **fresh pineapple**. At least 1 quart of good **water** is required in 24 hours, and if the patient's metabolism is deficient a mildly **saline water** will prove of great benefit. **Fresh air** as a means of nourishment is of special importance. E. P. Davis (*Amer. Jour. Obstet.*, July, 1919).

2. TRAUMA.—Injuries of various characters are not inhibited nor prevented by pregnancy. Some of them may be considered mere curiosities; for example, the tearing open of the pregnant womb by the horns of cattle, early delivery by Cæsarean section because of extensive pelvic deformity, kicks in the abdomen and other brutal treatment, penetration of the vagina and uterus by sticks or other hard objects, accidentally or intentionally. All these causes may produce intense disturbance: the de-

livery of the ovum, pain and inflammation, sepsis, and even death.

3. NERVOUS AND MENTAL IRRITANTS.—There are many causes of this nature which produce disturbance of one kind and another during the pregnant state. Sudden emotions of fear, surprise, grief, anger, etc., may produce unusual results, owing to the extreme sensitiveness which many women experience while pregnant. With one woman the result will be a general sense of pain or a neuralgia in some particular nerve or set of nerves. With another the result will be nausea with or without vomiting, with another diarrhea, while with others the uterus will be excited to contraction and its contents expelled. A very common result from such excitants is incontinence of urine, the urine being voided involuntarily with the slightest nervous or mental impression of an unusual character. The birthmarks or stigmata with which many children come into the world are often traceable only to mental impressions or a disordered imagination, and many of the monstrosities among infants may be fairly accounted for in this way. A woman whose mind is diseased may produce a persistent impression upon her unborn child which will manifest itself at a later period upon the child's physical or mental structure. Women with organic disease of the nervous system may so impress their offspring that they will succumb during the gestation period, or if carried to term will be of such defective structure that their entire lives will be burdensome to them.

4. INTERCURRENT DISEASES.—Of this form of irritant the acute and specific infections furnish a familiar

example. Any acute disease developing during pregnancy may not only be of a more severe type than would ordinarily occur, thus intensifying the patient's discomfort and suffering, but it may even cause the death of the child or its premature delivery, either alive or dead.

From our own viewpoint their influence is about as follows:—

Smallpox complicating pregnancy is more serious than at other times, the hemorrhagic form being particularly fatal. This disease has an injurious effect upon the product of conception, the occurrence of abortion or premature labor varying with the severity of the case, being almost universal in the hemorrhagic and comparatively frequent in the discrete variety.

Although it is generally believed that a certain immunity to *scarlet fever* exists in pregnancy, a number of cases have been reported, and when it occurs in the early months the disease frequently causes abortion.

Measles is not seen very frequently in pregnancy, but has been observed by Klotz to cause premature delivery. It is, however, much more serious during the puerperium than during pregnancy.

Cholera does not attack pregnant women more frequently than others; however, it is more fatal in these cases, Schütz giving a mortality of 57 per cent. in the Hamburg epidemic of 1892.

The incidence of *typhoid fever* is of serious import, and often dangerous. The fetal mortality is greatly increased, abortion or labor occurring in from 40 to 60 per cent. of the cases.

Pneumonia is another complication of pregnancy in which the maternal mortality is high, the disease frequently leading to premature labor or abortion.

The effects of *influenza* on pregnancy vary with the severity of the epidemic, a very pernicious influence being observed by Felkin and Müller, the interruption of pregnancy being preceded by profuse metrorrhagia. In a series of cases reported by Bar and Boullé, however, as well as by Ahlfeld, the disease influences gestation but slightly.

Erysipelas is a very serious complication and particularly dangerous in the pregnant state, the possibility of a streptococcic puerperal infection being markedly increased, though it does not occur invariably.

A general *septicemia* sometimes results from a streptococcic angina, and streptococci may be observed in the uterine lochia, as well as in the fetal blood.

Although the occurrence of *gonorrhea* in the pregnant state is not to be lightly considered, its appearance during labor or during the puerperium is of greater significance. After labor the gonococci may reach the uterine cavity and give rise to fever. Although rarely fatal, this condition is always serious, frequently involving the uterine appendages and causing sterility or necessitating future operative interference.

Tetanus, always a very dangerous disease, is rarely observed during pregnancy, and its prognosis is not influenced by this condition.

Anthrax, though rarely observed in human beings, is almost always fatal. Three deaths are reported in pregnant women by Rostowzen, anthrax

bacilli being demonstrated in the tissues of the child. Several other cases have also been reported.

The ordinary forms of *malaria* have but little influence upon the course of pregnancy; the pernicious form, however, may exert an injurious effect. There is a marked tendency to recrudescence of the disease during pregnancy and the puerperium.

5. IRRITATING CONDITIONS ASSOCIATED WITH THE OVUM.—Such conditions may consist in disease which has been transmitted from the mother (*e.g.*, **syphilis**), or there may be diseased conditions of the placenta or membranes which may react upon the mother. Especially if death of the ovum takes place and it then remains within the mother's body, it may be a source of disturbance to her. One of the most distressing illustrations of such possibilities is the wide range of untoward phenomena which are connected with ectopic gestation.

DISORDERS OF PREGNANCY.

These include the following conditions: vomiting, toxemia, ptyalism, displacements of the uterus, embolism and thrombosis, ectopic gestation, pruritus vulvæ, edema of the external genitals and of the upper and lower extremities; disorders of the thyroid, lymphatics, and adrenal glands; hemorrhoids, uterine pain or cramps, spurious pregnancy, concealed pregnancy.

NAUSEA, VOMITING, AND TOXEMIA.

Cases of vomiting naturally fall into two classes, one in which the vomiting merely accompanies the pregnancy and the other in which

pregnancy is the pathogenic factor. It is essential that these two classes be recognized and differentiated.

Vomiting Associated with Pregnancy.—Cases of vomiting occur during pregnancy which are due not to it but to acute intestinal obstruction, appendicitis, gastric carcinoma or ulcer, brain-tumor, or ovarian cyst with twisted pedicle. These cases diagnosed only on a post-mortem examination or when induction of labor has failed to relieve the patient are important, as they are generally thought to be toxemic in origin. Among the diseases which have given rise to error in diagnosis, other than those already mentioned, are: tuberculous peritonitis, strangulated Meckel's diverticulum, chronic alcoholism, hepatic carcinoma, gangrenous typhlitis, septic bronchial glands, and choriocarcinoma of the brain, kidney, and liver. In view of these diagnostic pitfalls a post-mortem examination should be made in all cases of patients who die from so-called toxemic vomiting.

Vomiting of Pregnancy.—For a number of years it has been the custom to divide the cases of vomiting due to pregnancy into three classes: those due to some disturbance of the nervous system, *neurotic vomiting*; to some uterine displacement, *reflex vomiting*; or to some disturbance of protein metabolism, *toxemic vomiting*.

The *neurotic form* has been ascribed to an irritability of the extensive nerve-supply of the uterus subjected to the unusual stimulus of pregnancy.

The disturbance begins soon after the uterus begins to enlarge, and continues with more or less persistency until the uterus is well out of the pelvis; that is, until the sixth or

seventh month of gestation, or even until its termination. It is familiarly known as "morning sickness," being apt to manifest itself when the patient awakens in the morning. If she remains quiet in bed nausea may be the only symptom, and even this may be wanting, but when she rises and makes any effort, nausea with vomiting may result. The ingestion of food usually adds to the discomfort. It may be quickly rejected or may become a disagreeable burden to be thrown off at a later period, or eventually it may be digested and assimilated. The symptom may become so troublesome that the resulting weakness and malnutrition prohibit attention to the daily duties. The patient may be obliged to keep her bed, and even her life may be in danger from inability to retain sufficient nutriment.

The cases of *reflex vomiting*, closely allied with the preceding group, have been described as those in which the vomiting, due to some displacement of the uterus, ceases when the displacement is corrected.

The *toxemic form* of vomiting has been recognized as being due to autointoxication, and when slight, as the condition usually is, it is again called morning sickness. When severe it is known as *hyperemesis gravidarum*, or "pernicious vomiting of pregnancy." The latter condition occurs generally in the first half of pregnancy, differing in this respect from eclampsia, which usually occurs in the latter half of pregnancy. It may be either acute or chronic. *Acute* cases are rare, and a fatal issue takes place usually in from ten to fourteen days. There is no fever; the pulse is little, if at all, accelerated, and ema-

ciation is not marked. The quantity of urine voided is large and it contains blood; the ammonia coefficient is very high. The *chronic* cases may last for several weeks. Three stages are observed—wasting, pyrexial, and mental. In the wasting stage the patient rapidly emaciates. The vomiting varies in frequency from several times a day to instant ejection of all food swallowed. Thirst is marked and there is more or less abdominal pain. The pyrexial stage is marked by a rise of temperature to 103° F. (39.4° C.) or beyond. The pulse is 120 or more. The tongue becomes dry and brown. Diarrhea may be present. At this stage abortion frequently occurs or the uterus is emptied by the physician. In either case recovery is the rule, otherwise the mental stage, marked by delirium or coma, appears and the result is nearly always fatal.

As a matter of fact, more recently there has been a tendency to discard the purely neurotic type of the vomiting of pregnancy, a strong suspicion having arisen that the vomiting may, perhaps, be *always* in some degree of toxic origin, though frequently aggravated by neurotic, including reflex, conditions. The symptom is regarded as one of the manifestations of the toxemia of pregnancy, the latter, in turn, having been variously accounted for on the basis of insufficient hepatic activity, toxic absorption from the bowel, invasion of the maternal organism by syncytial toxins, lack of secretion from the corpus luteum, renal impairment, a deficiency of carbohydrates in the diet, etc.

There are described an *early toxemia* and a *late toxemia* of pregnancy, the first of which is manifested chiefly,

though not wholly, by nausea and vomiting, while the latter comprises manifestations the culminating fury of which is seen in the eclamptic seizure (see PRE-ECLAMPTIC TOXEMIA, p. 604, this volume). It seems most probable that the early toxemia is of syncytial, or placental-cell, origin; the late toxemia is primarily of fetal origin, but may be influenced or aggravated by syncytial products, as well as by extra-genital poisons such as those from the gastrointestinal tract.

The theory of intoxication by the growing ovum during pregnancy is verified most plainly by the demonstration of Schmorl that foreign fetal material in the form of small pieces of syncytial protoplasm may appear in the maternal circulation. In all healthy women, it is believed, most of the toxin is counteracted through the immunizing activities of the mother. Where such immunization, however, is imperfect, the toxic material continues to circulate in the blood-stream in undue amount, and in many instances, among the earlier evidences of this condition, nausea and vomiting are produced, owing to direct irritation of the nerve center concerned.

Changes in the liver are clearly recognized, according to F. D. Lynch, in the pathology of the vomiting of pregnancy. Mild cases, dying of some other condition, show little more than a cloudy swelling of the liver parenchyma, but all or nearly all fatal cases show decided structural changes, varying from simple fatty degeneration to acute yellow atrophy.

The different pregnancy toxicoses are all consequences of the passage of proteinogenous amines or their cleavage products into the blood stream. The amines come from the placenta, the bowel, or the endocrine

glands, especially the pituitary-suprarenal system and the thyroid. The writer's researches have demonstrated the presence of these amines in the blood. They are probably of the histamin type. When the liver becomes exhausted by the excessive work imposed on it, the unmodified amines have a toxic action, which is felt predominantly in the organs which are the less resistant in the individual. If the retinal vessels feel the spasm, there is disturbance in vision; if the cerebral vessels are affected, we have eclampsia. Edema, nephropathy and eclampsia are merely different degrees of the same disturbance. Hüsey (Schweizer med. Woch., Oct. 7, 1920).

In serious toxemic vomiting the urine is scanty and may contain albumin, casts, blood, acetone, and diacetic acid. Marked variations in the excretion of nitrogenous substances may occur. The ammonia coefficient, normally 3 to 5 per cent., may be raised to 10 up to 46 per cent (Berkeley and Bonney). While influenced by diet, medication, and other factors, ammonia excretion is regarded as a serviceable index of the degree of functional adequacy of the liver. It is increased in the presence of acidosis and is asserted to serve the purpose of saving alkali for the body. According to J. L. Williams, toxic vomiting is associated with a marked increase of the uric acid in the blood, while nervous vomiting is not.

In the blood of patients with eclampsia, hyperemesis gravidarum, and with the symptoms of pre-eclamptic toxemia, together with arterial hypertension, the uric acid is markedly increased. Delivery and recovery from the symptoms are associated with a gradual return of the uric acid in the blood to its normal amount. It seems possible to differentiate toxic and nervous vomiting of pregnancy by quantitative esti-

mations of the uric acid in the blood. J. L. Williams (Jour. Amer. Med. Assoc., May 7, 1921).

The well known participation of the liver in the disturbance in many of these cases, due to its unsuccessful efforts as detoxicating organ to get rid of the excess of toxic material circulating in the blood, lends importance to the living habits of the patient, indicating in particular how dietary indiscretions might, by overburdening the liver, initiate or aggravate the disorder.

PROPHYLAXIS.—The "morning sickness" of pregnancy, of whatever degree of severity, need no longer be considered a physiologic condition that must be expected and endured, but is a disorder which is either wholly preventable or reducible to a negligible minimum—provided the physician is able to see his patients and control their manner of living as soon as they suspect pregnancy or begin to experience morning sickness as a first evidence of toxemia.

In a very large percentage of cases the digestive tract holds the balance of power, as it were, in the struggle that is ever present in the pregnant woman between the toxins of pregnancy, of whatever nature they may be, and the protective ferments of her blood. Especially is this true of the late or "pre-eclamptic" toxemia. Barring the relatively few cases in which organic disease is known to exist, if the intestinal tract can be kept normal and clean, without resorting to the very common and pernicious use of purgatives, the natural protective forces will maintain the ascendancy and there will be little or no evidence of the presence of toxemia. Again, very real dangers arise in this connection from the pernicious practice of overeating or injudicious

eating, a practice indulged in by the pregnant woman, like every one else, particularly in the midwinter holiday period and the midsummer vacation season. Hospital records clearly show a decided increase in the number and severity of eclampsia cases at these two seasons of the year.

Undoubtedly, the most effective measures that can be applied for the prevention of pregnancy toxemia consist of definite, practical instructions on *how*, *when*, and *what to eat and drink*.

Careful observation and experience extending over a number of years have convinced the writer of the great value and efficacy of the following routine instructions which he issues to the pregnant woman:

(1) The entire food allowance for the 24 hours is to be divided as nearly as possible into 5 equal portions, to be taken every 3 hours. No other food is to be taken *after* or *before* or *between* these meals. There is to be no "big meal," and especially not the usual evening dinner.

(2) The patient may have a fairly liberal variety of foods as long as they are known to be nutritious and digestible. Her drink is to be limited almost entirely to water and milk, the latter to constitute the basis of each of the 5 meals; 5 glasses of milk a day, with good bread and butter, some of the breakfast foods or cereals, with plenty of cream and sugar; properly cooked potatoes; green vegetables, such as lettuce, spinach, or celery; a moderate amount of good fruits, occasionally an egg, a small portion of fish, or even a small allowance of red meat 2 or 3 times a week.

(3) As often as she eats, or 5 times a day, she is to take at least a half teaspoonful of **bicarbonate of soda**, or its equivalent in some other alkali, such as the **milk of magnesia**; this alkali is to be increased or decreased according to its effects on the reaction of the urine and the general condition of the patient.

Of course, much more than this, and much that is different from this, must often be said to suit individual cases. The general plan, however, constitutes the most effective means the writer has ever found to prevent overeating. More women come to grief from eating too much than from eating too little, but the plan above outlined, if properly followed, prevents both overeating and undereating. The amount of sodium bicarbonate to be given is that which will maintain slight alkalinity of the urine.

TREATMENT.—In the active treatment of the vomiting and toxemia of pregnancy, **rest** is an important measure. Rest in bed may, in the milder cases of nausea and vomiting, be all that is required, the woman gradually resuming her customary duties as the stomach becomes less irritable.

In more obstinate cases, including those of pernicious vomiting, the writer has had uniformly good results for years from a plan of treatment consisting of rest in bed for a week or two combined with certain dietetic and pharmacetic measures: For the first 3 days or longer, **no food by mouth** is allowed, the patient being given by **Murphy drip**, after an initial cleansing of the bowel with copious **enemas**, a solution consisting of **sodium bicarbonate**, 6 drams (24 Gm.), **sodium bromide**, 2 drams (8 Gm.), and **glucose**, 2 ounces (64 Gm.), to the quart (950 c.c.) of **normal saline solution**. This drip treatment is given for 3 hours at a time, at intervals likewise of 3 hours, and continued until the quantity and quality of the urine are satisfactory. Meanwhile nothing is given by mouth except water containing **sodium bicarbonate**, 10 grains (0.6 Gm.) to the ounce (30 c.c.),

which is given freely, partly for the purpose of washing out the stomach when the patient vomits.

After the desired relief has been obtained the patient is allowed food when she wants it, and of practically whatever kind she desires. Sufficient alkali is continued by the mouth, however, to cause the urine to remain alkaline in reaction.

Under this treatment the condition nearly always improves rapidly, even in "pernicious" vomiting. The results obtained are so uniform that the writer has not found it necessary to empty the uterus in such cases for many years.

The writers believe that a deficiency in carbohydrates has an important bearing on the origin of toxemia of pregnancy. Pathologic changes in the liver lobules similar to those of fatal toxemias of pregnancy can be made to disappear rapidly by ingestion of **carbohydrates**. Mild cases of nausea and vomiting may be controlled by giving a preponderance of carbohydrates, and taking food more frequently than usual. The patient should also be given from 8 to 16 ounces (240 to 480 c.c.) of 10 per cent. **glucose** and 2 per cent. **sodium bicarbonate solution** daily by mouth in 1- or 2-ounce (30- or 60-c.c.) doses. In more severe cases, after an initial period of **rest, gastric lavage** and **saline cathartics through the stomach tube**, small amounts of **liquid food** are allowed, alternating with from 1 to 2 ounces of the glucose and soda solution, every 2 hours. In seriously toxic patients intravenous injections of 15 to 25 Gm. (4 to 6¼ drams) of glucose in 250 to 300 c.c. (½ to ¾ pints) of water, are given 1 to 3 or more times daily. Titus, Hoffman and Givens (Jour. Amer. Med. Assoc., Mar. 20, 1920).

Another procedure that has proven of value in severe cases is the administration of 20 c.c. of inactivated **blood**

serum of a non-toxemic pregnant woman.

Among other measures that have been availed of in the past but are now rarely, if ever, indicated in view of the successful results obtained from the above treatment are:

Bismuth subnitrate and **cerium oxalate** by the mouth; **wine of ipecac**, 5 minims (0.3 c.c.) in an ounce (30 c.c.) of water every four hours; **liquor acidi arsenosi** in small doses; **bromides** in large doses; **barbital**, 20 grains (1.3 Gm.) by the rectum; **chloral hydrate**, 20 grains (1.3 Gm.); **silver nitrate**, ¼ grain (0.16 Gm.) in capsules; **menthol**, 2 grains (0.13 Gm.); **cocaine**, ½ grain (0.03 Gm.) and **monobromated camphor**, 3 grains (0.2 Gm.) in a capsule; **adrenalin**, 10 drops of the 1:1000 solution in normal saline solution, and **washing out the stomach** with large amounts of warm water or saline solution every morning.

Horse serum in doses of 5 drams (20 c.c.), repeated as required, has been successful in some cases of vomiting of pregnancy.

Corpus luteum injections have been used with considerable success by J. C. Hirst and other observers.

The control of nausea and vomiting of pregnancy by intramuscular injections of **corpus luteum** was studied by the writer in 111 consecutive, unselected cases. Favorable results were obtained in 99 cases or 89.2 per cent. He believes that the lack of normal corpus luteum absorption is a factor of the morbid process. Preference should be given to an extract prepared from the ovaries of pregnant sheep, cow or pig. J. C. Hirst (Amer. Jour. Obstet., March, 1919).

The writer believes that the pituitary and suprarenals play an import-

ant part in pregnancy disturbances. Severe hyperemesis at the second month and eclampsia at the ninth month in 2 primiparæ treated with **ovarian extract** showed marked benefit. The extract should be given early and freely. He also warns against **chloral** for more than a single dose of 2 Gm. (30 grains) by the rectum. Hofbauer (*Zentralbl. f. Gynäk.*, Feb. 7, 1920).

Intravenous injection is the ideal method of administration of **corpus luteum**. Ampoules containing 0.2 Gm. of the dried substance in solution in 1 c.c. of physiologic sodium chloride solution are available for this purpose. For the last 2 years the writer's assistants and he have used no other method, whether in dispensary and office patients or in bedridden patients in the hospital or private homes. A glass hypodermic syringe of 3 c.c. capacity, prepared by boiling and cooled, is used. Ambulatory patients usually receive 2 c.c. every other day. In more severe cases, when office visits would be a hardship, the patients receive 2 c.c. daily, given at home. In pernicious cases 2 c.c. are given twice daily. Patients should receive at least 12 c.c. entirely irrespective of the fact that they respond quickly and favorably to a smaller number. If fewer are used relapses are common, and are more difficult to control than the original attack.

Anaphylactic reactions need not be feared. The results are more gratifying, more prompt, and more lasting than by any other method. J. C. Hirst (*Jour. Amer. Med. Assoc.*, Mar. 19, 1921).

If the patient does not respond to any of the measures mentioned, but continues to grow worse, if the ammonia content is increasing or is over 10 per cent. and the clinical signs and symptoms of the fever stage are marked, **labor** should be **induced** (Berkeley and Bonney).

Painting the os uteri with **tincture of iodine** arrests the vomiting at once, in most instances. One application is usually enough. Johnson (*Amer. Jour. of Clin. Med.*, June, 1917).

TOXEMIA OF PREGNANCY.

The condition sometimes termed "pre-eclamptic toxemia"—owing to the frequency with which it is accompanied by convulsions (see **PUERPERAL ECLAMPSIA**, page 722, this volume)—or the "late toxemia of pregnancy," is due to the presence in the blood of poisonous substances, maternal and fetal. The former are believed to be toxic wastes of hepatic, renal or systemic origin; the latter waste or by-products excreted by the fetus or placenta, owing probably to defective hydrolysis. Of late, foci of infection have been traced to the tonsils, teeth, kidneys and intestines.

SYMPTOMS.—The early symptoms of pregnancy toxemia are persistent headache, located mainly about the forehead, and sometimes severe, *muscæ volitantes*, and more or less persistent epigastric pain, often accompanied by nausea and vomiting, and vertigo. Constipation and the converse, diarrhea, may also occur. The volume of urine voided is usually reduced and often contains albumen. It is sometimes necessary to examine a catheterized specimen. The nitrogen excretion is lowered.

The toxemia becomes more defined, The tongue previously coated, becomes dry and red, the gums likewise red, and the skin particularly that of the face, muddy. A blood-pressure of 160 or over, and a high tension pulse are also common. Insomnia and disturbances of vision, irritability, twitching, are common. The presence of edema especially including

the eyelids, upper extremities and labia, denotes a severe case.

TREATMENT.—The aim in these cases is to prevent eclampsia (*q.v.*) by reducing the formation of wastes and promoting their excretion. Absolute **rest in bed**, a **milk diet** and eliminants, such as **magnesium sulphate** until free purgation is produced, **large quantities of water** as beverage, colonic irrigations with **hot saline solution** and also to promote elimination by the skin, **hot baths**, and if eclampsia threatens, **hot pack**. **Bland foods** and **avoidance of meats** tend powerfully to prevent convulsions. This is also aided by **gastric lavage** with a solution of **sodium bicarbonate**, a procedure which as a rule promptly relieves the gastric pain. A powder containing 10 grains each of **sodium bicarbonate**, **bismuth carbonate** and **calcined magnesia**, given in a glassful of water every three hours opposes acidosis, a prominent factor in the production of convulsions. If the latter threaten, **venesection** followed at once by **intravenous** infusions of **saline solution** will do much to prevent them. **Elimination of infectious foci** may be necessary. Striking results from the **removal of dental abscesses** have been reported by Loomis. If all of these prophylactic measures fail **emptying of the uterus** may become imperative.

All other measures failing, the final resort is to **empty the uterus** under ether anesthesia. Preliminary gradual dilatation with Hegar's dilators up to No. 20 should be effected. If at term, the Voorhees bag No. 4, introduced by Reed's method as a cigarette roll held by Péan's forceps, is useful. **Lavage** with 2 per cent. **sodium bicarbonate** solution after emptying the uterus is advocated.

Mosher (Amer. Jour. of Obstet., Dec., 1918).

For the treatment of eclampsia see **PUERPERAL ECLAMPSIA**, this volume.

PTYALISM.

This consists in an irritability of the salivary glands, in which the saliva is poured out in an almost constant stream. It is apt to occur with primiparæ, and in the first three or four months of pregnancy. Its effect is to weaken the patient and impair the digestive function. The quantity of saliva secreted in the twenty-four hours may amount to one or more pints. The saliva may be purely fluid or watery, or it may be mingled with an abundance of mucus, and be thick and ropy. This disorder is more common in the earlier months of pregnancy and is often associated with vomiting, and is considered to be a reflex neurosis in some cases, while in others an auto-intoxication. The patient's health may suffer if the ptyalism is profuse.

TREATMENT.—There is no remedy for this trouble which compares with **atropine sulphate**. It may be given in $\frac{1}{130}$ -grain (0.0005 Gm.) doses repeated every three or four hours until physiological effects are apparent. An alkaline and astringent **mouth-wash** composed of **alum** 1 dram (4 Gm.) to 1 pint (500 c.c.) of water, is useful in conjunction with the atropine treatment.

In severe cases a **strict milk diet** should be ordered, with careful **regulation of the bowels**, with a view of preventing auto-intoxication.

Case of excessive salivation in a woman of 36, who also lost 25 pounds in weight. When **ovarian treatment** was given, she regained nearly 9

pounds in 4 days. Boissard (*L'Obstétrique*, Jan., 1910).

DISPLACEMENTS OF THE UTERUS.

Uterine displacement may be present when pregnancy is initiated or it may be acquired during any period of gestation. It may be lateral, anterior, or posterior, and it may be more or less exaggerated. It may be simple or it may be complicated by adhesion of the peritoneal surface to the contiguous peritoneum. Whether the adherence exists at the beginning of pregnancy or is acquired subsequently, it is always an unfortunate—not to say a dangerous—complication in so far as the continuance of pregnancy is concerned.

The least significant, in so far as disturbance to the pregnant state is concerned, are lateral displacements. If there are no adhesions the uterus usually corrects itself as pregnancy advances, and if no other complication supervenes parturition will follow in the natural sequence and involution will restore the organ to its normal place and relations in the pelvis. If adhesions exist or are acquired, they may be pulled apart as the uterus enlarges, or their firmness may be such that they will not yield, uterine contractions being excited and the uterine contents expelled, or the latter may require removal at the hands of the physician. Anterior displacement may be slight or extensive and the uterus may or may not be adherent to the bladder. If the displacement is slight and there are no adhesions, spontaneous correction will result as the uterus enlarges and no further difficulty from this source may follow.

When the displacement is exten-

sive, the subsequent enlargement of the uterus will be asymmetrical, the function of the bladder will be encroached upon, and there will be constant irritation of that viscus, with frequent micturition, and possibly the development of an annoying cystitis. This may continue until the end of pregnancy, or the irritation may be so great that uterine contraction and abortion will result. The danger of this mishap is greatly increased if the uterus has become adherent to the bladder. After the uterus has been emptied the union to the bladder may persist with such annoying symptoms that a surgical operation may be required to effect relief.

When the uterus is displaced posteriorly the difficulties and dangers will usually be greater than in either of the other varieties of displacement. It may be merely retroverted or acutely retroflexed. If the former, and there are no adhesions, nature may again correct the trouble and no further difficulty ensue. If adhesions are present, the enlargement of the uterus will almost certainly produce such irritation that contractions and abortion will follow. In 24,000 pregnant women Martin found 121 cases of retroversion and retroflexion, and in 94 cases retroversion persisted after repeated pregnancies.

Case of pregnant uterus resting in the position of lateroflexion which was mistaken for an ovarian cyst. Notwithstanding laparotomy the pregnancy continued to term and the patient was delivered of a living child weighing 3500 grams. Lateroflexion of the pregnant uterus may be confounded with ectopic pregnancy, ovarian cyst, or salpingitis. Concordance with Mauriceau in the importance of making the diagnosis as early as possible in order that the displacement

may be corrected. The **expectant plan** may be adopted or, if the flexion is so strong and irreducible as to be incompatible with the normal evolution of the pregnancy, an **exploratory incision** should be performed and the **uterus freed**. M. H. Varnier (*Annales de gynéc. et d'obstét.*, Feb., 1901).

Case of right-sided lateroflexion of the pregnant uterus which was mistaken for an extra-uterine pregnancy. Laparotomy was performed; the **uterus** was **replaced**, but abortion followed. The patient made an uninterrupted recovery otherwise. Rou-tier (*Annales de gynéc. et d'obstét.*, Feb., 1901).

In acute retroflexion the displacement may be remedied as it enlarges, but too much cannot be placed upon the unaided effort of nature. It will be far better to place the patient in the **knee-elbow position**, restore the **organ to its normal position** with the fingers, and then **secure it with a tampon or a suitable pessary**.

Many cases are susceptible of relief by such means which would otherwise terminate in abortion. If the uterus is retroflexed and also fixed by adhesions, relief may be obtained by the judicious use of the **tampon or pessary**, or the **adhesions** may be **liberated** as the organ enlarges; but in the majority of cases an abortion will be the result. With this displacement there are usually various annoying complications: The rectum is irritable from the constant pressure upon it and a troublesome diarrhea or an equally troublesome constipation may ensue. Relief will come only when the cause has been removed. The bladder may also give trouble, owing to the constant traction at its neck, and the patient will be distressed with

constant desire to micturate, each effort being followed by tenesmus. All things considered, uterine displacements bring about as much discomfort as any of the disorders to which the pregnant woman is subject.

Two cases of pregnancy in a retroflexed adherent uterus. The writer recommends: (1) **prompt operation** as soon as the diagnosis under anesthesia has been confirmed; (2) **separation of adhesions and reposition of uterus**, but avoidance of all attempts at radical treatment or any other operative steps endangering the continuance of pregnancy. When operating before the end of the second month, the introduction of a **pessary** for a short period will prevent a return of the displacement without any danger to the fetus. Werder (*Amer. Jour. of Obstet.*, Feb., 1911).

Ventrofixation in a pregnant woman is a very serious operation, as it may complicate subsequent labors. In a personal case the difficulty arose from a rigid, unyielding body of the uterus when it was fastened to the abdominal wall. Rocoff (*Roussky Vrach*, May 5, 1912).

In the treatment of incarcerated pregnant uterus, no attempt should be made to straighten the uterus until after the bladder has been emptied. If it proves impossible to introduce a catheter, we must not hesitate to puncture the bladder above the symphysis. The rectum must also be cleared out.

After this is done, the **uterus** must be **straightened**; it helps sometimes to draw down the cervix with forceps to leave more room above. The knee-chest position may help or general anesthesia may be necessary. During this it may be possible to break up adhesions.

Once the condition corrected, a **pessary** should always be introduced to keep things in place, removing it at the fifth month. P. Jung (*Deut. med. Woch.*, April 2, 1914).

EMBOLISM AND THROMBOSIS.

Pregnancy is often attended with enlargement of the veins, those of the lower extremities and vulva being most frequently implicated. The condition is less common in primiparæ than in multiparæ. If the vascular tension be weak the formation of thrombi is favored. Portions of these thrombi may be detached as emboli and, passing onward, may find their way into the arterial circulation, especially into the arteries of the lungs and brain. When arrested in these vessels the most violent symptoms may ensue: pain, dyspnea, effusion, even death. Such accidents, however, are more frequently the sequences of labor, especially when the thrombi are formed within the uterus at the site of the placenta. Pregnant women who suffer with varicose veins should always be cautioned against violent exertions or anything which would tend to the formation of thrombi, or to their disintegration when formed.

TREATMENT.—The treatment in such cases must necessarily be expectant and stimulating, the patient being kept **in bed** most of the time upon **fluid diet**. If it is necessary or desirable that she should be up and around, the **feet and legs** should be **bandaged** (the elastic crêpe bandage is best), but not too firmly.

ECTOPIC GESTATION.

Although this condition rarely occurs as a complication in conjunction with an intrauterine pregnancy, such cases are not unknown.

Instance of intra-uterine and extra-uterine twin pregnancy. The patient was in her third pregnancy, her first having been twins with dead children

of the same sex. The second pregnancy terminated in normal labor. During the second month of the third pregnancy she had violent pain in the lower abdomen with shock. Pregnancy continued, however, until near term, when she gave birth in spontaneous labor to a male fetus 45 cm. long. An hour later she complained of severe pain in the lower abdomen, which gradually ceased and returned the following day. She was admitted to hospital with a diagnosis of ectopic pregnancy. On examination a fetus could be palpated in the abdomen, and heart sounds could be heard. This was confirmed by **operation**, a living fetus being found in a sac without amniotic liquid, with pulsating cord and placenta partly adherent to the omentum. The child was rapidly delivered and the placenta was removed with unusual facility. Bogdanovics (*Zentralbl. f. Gynäk.*, Nu. 22, 1914).

When tubal pregnancy ends, the uterus undergoes involution: (1) by destroying recently developed tissue, and (2) by reconstructing new and normal tissue. The first takes place by free hemorrhage from the endometrium, with destruction of cells and filling of venous spaces. In the tube a similar process goes on, so that chorionic villi may remain in active condition in the tube indefinitely. Sampson (*Surg., Gynec. and Obstet.*, May, 1914).

In reviewing 100 cases reported in the literature in which pregnancy had continued for more than 24 weeks, the writer found that 77 per cent. went to term. The pregnancy was normal in 33 per cent. of the cases. In 50 per cent. there were abdominal symptoms, probably at the time of rupture or hemorrhage. In 1 case eclampsia developed during labor. In 3 per cent. of the cases there was extra- and intra-uterine pregnancy. Seventy-four of the patients were not operated upon and there were no complications. In 33 per cent. there were symptoms of infection. These symptoms occurred as early as 10

days and as late as 15 years after labor or the death of the fetus. Ley (Proc. Roy. Soc. Med., London, Sect. Obstet. and Gynec., xii, p. 140, 1919).

Rupture of the sac having already been treated in the first volume by Dr. John B. Deaver, under the title ABORTION, TUBAL, it will only be briefly reviewed in the present connection.

The sac ruptures, as a rule, from the sixth to the tenth week of its history and it would be almost an impossibility for ectopic gestation to occur after uterogestation had been established. If, therefore, the two conditions coexist, the former will usually begin coincidentally with the latter or a short time—a few weeks—previously. Uterogestation usually causes the abeyance of menstruation, but when it coexists with ectopic gestation one of the first symptoms indicative of the situation will be hemorrhage; this may appear at the customary time for menstruation, thus misleading the patient with regard to her condition, or it may appear a few days or weeks subsequently. But it will differ from the customary menstrual flow by its continuance after the usual duration, and also by its greater abundance. This fact may serve to warn the patient that her condition is not that which attends ordinary menstruation. The bleeding may or may not be attended by the discharge of shreds of decidua, this being by no means a constant symptom.

A study of 147 cases of extra-uterine pregnancy showed that 19 per cent. occurred in primiparous women; 8 per cent. were illegitimate pregnancies; 30 per cent. had a history of previous abortion; and that in 28 per cent. the preceding pregnancy

had terminated prematurely. The average interval after an intra-uterine pregnancy until the extra-uterine pregnancy developed was 45 months. The average interval between the 2 attacks in the 7 cases in which the condition was repeated was 2 years. Recovery was noted for each of the 17 patients operated on in shock. Sterilization was performed 18 times; in 8 of these cases the opposite tube had been previously removed; 30 cases (52 per cent.) of the 58 cases whose subsequent history is known did not develop any later pregnancies; 39 intra-uterine pregnancies have developed subsequent to the extra-uterine condition, 28 ending at term, 8 aborting, while 3 are at present pregnant. The extra-uterine pregnancy was repeated 7 times, a ratio to the intra-uterine pregnancies of 1 to 5.5. Williams (Amer. Jour. of Obstet., June, 1913).

Pain, due to both a stretching of the abnormal gestation sac and its subsequent rupture with hemorrhage either into the peritoneal cavity or into the space between the folds of the broad ligament, is suggestive. It is sharp and cramp-like; recurs in frequent paroxysms, and may be so severe that it, in connection with the accompanying concealed hemorrhage, may result in anemia and collapse. If the rupture occurs at a very early period the fetus (ectopic) may die and be absorbed together with the effused blood. The uterine gestation may terminate with an early abortion; but this rule need not be considered invariable.

Valuable early symptom of extra-uterine gestation in certain cases. If at the first examination there is nothing present in Douglas's pouch, while later there is an increase in resistance, the diagnosis of an extra-uterine gestation may be made. Case in which the writer made the diagnosis, although the Abderhalden reaction

proved negative. At the operation there was found a small clot in Douglas's pouch, and just above on the right side was a tubal gestation sac. Close to the abdominal end of the tube was a small opening through which blood had oozed. Solowij (*Zentralbl. f. Gynäk.*, Nov., 1913).

In the sign described by Solowij, the doughy resistance in the pouch of Douglas is due to small accumulations of blood, hence its early diagnostic importance. Bertolini (*Zentralbl. f. Gynäk.*, April 27, 1912).

The writer resorts to the **posterior** and **anterior colpoceliotomy** to aid him in diagnosing ectopic gestation in difficult and doubtful cases. The dark-blue shimmer back of the exposed vesico-uterine fold of peritoneum is very characteristic. Bandler (*Arch. of Diag.*, April, 1912).

In cases of jaundice of obscure origin, the discovery of hematin in the blood-serum served to confirm the suspicion of ruptured extra-uterine pregnancy. The spectroscope revealing the hematin indicated the necessity for an immediate operation. Schottmüller (*Münch. med. Woch.*, Feb. 3, 1914).

After rupture of a pregnant tube, even if any accumulation of blood in the pouch of Douglas cannot be palpated, deep palpation will often elicit sharp sudden pain, so that even when the patient is half swooning, it will make her cry out.

The contrast between the soft depressibility of the pouch and this severe pain on deep palpation is very significant, especially when the rectus muscle shows no signs of contracture.

This sign was always pronounced in all the writer's cases, and in many instances gave the first clue to the nature of the disease.

In several typical cases the rupture occurred before any arrest of menstruation had been noticed. Proust (*Paris méd.*, Aug. 7, 1920).

TREATMENT.—The treatment of this condition has been fully de-

scribed by Dr. John B. Deaver, in the article on ABORTION, TUBAL, in the first volume, page 184, to which the reader is referred.

The treatment of abdominal pregnancy was studied in 240 reported cases by the writer, in respect to the best time to operate. After the 6th month the best time proved to be the 10th month. The reason for this appeared to be that in the last month only 30 per cent. of the fatal maternal cases died of hemorrhage, while before this period 60 per cent. succumbed in this way. From the standpoint of the child the best time to operate was found to be just before the last 2 weeks of pregnancy. The management of the placenta in these cases is the main difficulty. Yet the mortality has gradually been reduced to 11.1 per cent. in cases in which the placenta was removed. Such removal should be effected wherever possible. In cases in which the placenta has been left and the wound drained until it came away, the mortality has been 38.7 per cent. Closure of the abdomen in such cases deserves more extensive trial. There is little risk in delaying operation until the 38th week of pregnancy, provided the patient is kept under observation. At the operation handling of the placenta should be very gentle. The vessels in the placental site should be ligated before removal of the placenta is attempted. The retained placenta is ultimately absorbed, as shown in an experimental performance upon a dog. A. C. Beck (*Trans. Amer. Med. Assoc.*; *N. Y. Med. Jour.*, June 28, 1919).

PRURITUS VULVÆ.

This annoying condition, which occurs in primiparæ as well as in multiparæ, consists in an intense and intolerable itching of the skin of the labia and circumanal region and sometimes the mucous membrane of the vagina. It is especially annoying at night after the patient has re-

tired to her bed. The rubbing and scratching provoked induce excoriation and sometimes severe inflammation of the skin, often lead to the formation of the masturbation habit, and may make the patient's life truly miserable. There may be very little external evidence of disturbance, or the skin may show cracks and abrasions. It is sometimes dry, red, and parchment-like; in other cases it is moist, with transuded serum, and the entire vulva may be swollen, hot, and painful to the touch.

Pruritus vulvæ may be attributed to four principal causes: 1. Discharges from the vagina or cervical canal. 2. Parasites of the skin. 3. Irritation of cutaneous nerve-endings of central origin. 4. Glycosuria.

Discharges from the Vagina or Cervical Canal.—The turgid, congested condition of the vagina and uterus during pregnancy conduces to the hypersecretion of glandular fluid and the transudation of serum from the vessels. This discharge may be bland and unirritating or it may be acrid and corrosive. Want of cleanliness and possibly the action of the bacteria of the skin favor the development of the troublesome condition. The discharge may be white and watery or colorless and slimy, and it may be scanty or abundant.

DIAGNOSIS.—The urine should be examined to exclude glycosuria. *Leukoplakic vulvitis*, which is attended by intense pruritus, should also be excluded. The latter occurs as a whitish thickening of the surface of the vulvæ, especially of the labia minora and the inner surface of the labia majora; later, cracks and fissures appear. The liability of this disease to become carcinomatous in

character makes its early detection important.

TREATMENT.—An efficient measure in the treatment of this condition consists in **drying the skin and mucous membrane** with absorbent cotton, **tamponing the vagina** with cotton-wool soaked with a paste of **glycerin and bismuth subnitrate**, and covering the skin with a thick layer of the same. This should be repeated daily and will usually bring relief.

Ichthyol is indicated in all cases of vulvar pruritus, used either as a 10 per cent. ointment, plaster, or lotion (aqueous).

If the itching is due to cutaneous parasites, these are the ordinary *Pediculi pubis*, which adhere tenaciously to the roots of the hair of the vulva. **Mercurial ointment** rubbed into the skin a few days in succession will destroy them.

When the pruritus is of central origin the cutaneous nerves are irritated, reflexly. Diabetes may produce this condition, though the irritant, in some cases at least, is the urine, which has been allowed to soil the skin. The treatment will consist, first, as in all cases, of **cleanliness**, then the application of the **glycerin-and-bismuth paste** or of **vaselin or zinc ointment** with which a sufficient quantity of **morphine, cocaine, or phenol** (15 grains—1 Gm.—to the ounce—30 Gm.—will usually suffice) has been combined. The causative disease must, of course, receive proper treatment at the same time. The internal use of **bromides** and **ichthyol** are indicated.

According to Pardo, the **X-rays**, in the dose of $\frac{1}{4}$ H. twice a week, are frequently curative.

EDEMA.

Causes of edema are many: **Pressure** of the pregnant uterus on the pelvic veins; renal disease; heart disease; impaction of the uterus or of the fetal head; thrombosis of the femoral or brachial veins; in some cases no definite cause can be discovered.

Edema of the external genitals, the lower and upper extremities, may properly be considered together, for it in all cases results from the same cause,—namely: interference with the venous circulation,—the first being more frequent than the other two.

Edema of the vulva is quite common, the tissue becoming quite dark, sometimes almost black. The veins may be greatly enlarged and the swelling of the tissues so extensive as to be painful and make locomotion difficult. The treatment consists in the application of **cooling** and **astringent** lotions, and **rest in bed** the greater portion of the time. This and the other two conditions are accompaniments of the later months of pregnancy when the weight and pressure of the heavy womb impair the freedom of circulation of the blood-current. Edema of the lower extremities is especially apt to occur with those who suffer with varicose veins of the legs, with cooks and washerwomen, and others whose duties compel them to be standing from morning until night.

TREATMENT.—**Rest in the horizontal position** is all-important. **Bandaging the feet and legs**, the bandage being carried well above the knees, will often give comfort and enable the patient to go about in the pursuit of her ordinary duties. In edema of the upper extremities appropriate treatment of the central cause

and **rest in bed** are imperative. The **limbs** should be lightly **bandaged** from hand to shoulder if the swelling is considerable. When the edema is intense, it may be necessary to **induce labor**. **Southey's tubes** in the legs may accord temporary relief. Where extreme swelling prevents access to the vagina, or would prevent the birth of the child, **multiple incisions** will give relief.

DISORDERS OF THE THYROID, LYMPHATICS, AND ADRENAL GLANDS.

SIMPLE GOITER.—The association of goiter and pregnancy is not rare. Goiter when already present rapidly increases in size on the occurrence of pregnancy, or its first appearance may be during pregnancy.

Symptoms.—Severe attacks of dyspnea usually occur and death has occurred from suffocation. In the puerperium the goiter is subject to puerperal infection, in which case there may be abscess formation within the gland.

Treatment.—The administration of **iodine** in the form of the **tincture** and the **iodides of potassium and sodium** is indicated. **Ionic medication** has been advised—a saturated solution of potassium iodide being applied on the cathode, a current of 25 milliampères being used, and the sitting lasting twenty minutes daily. **Thyroidec-tomy** entire or partial has been successfully used. In extreme cases **labor** must be **induced**.

EXOPHTHALMIC GOITER.—This may be present before or develop during pregnancy.

Symptoms.—If previously present, the usual symptoms of the disease

are more pronounced when the patient becomes pregnant. The goiter may rapidly increase in size and demand attention. The increased strain on the heart produced by pregnancy is added to that organ already impaired by the persistent tachycardia. Vomiting, emaciation, and fever are not uncommonly present and, sometimes, jaundice. Exophthalmic goiter is a contraindication to pregnancy and patients should be informed of the dangers incurred. The symptoms often improve, and may disappear, after delivery.

Treatment.—In the milder cases where pregnancy may be allowed to proceed, **absolute rest** should be enjoined, as the pulse is usually 30 or 40 beats less in the recumbent posture. In cases with acute symptoms, or where they are rapidly becoming worse, **labor** should be **induced**.

If partial **thyroidectomy** or **ligation of the arteries** is considered, the **uterus** should be first **emptied**. If an anesthetic is deemed necessary during the labor, **lumbar puncture** with injection of **morphine** **scopolamine** will be found safer than ether or chloroform. If rapid delivery is indicated, vaginal Cesarean section is to be preferred in the early months; at or near term, the abdominal operation is the best.

MYXEDEMA.—Myxedema is a rare complication of pregnancy. Cases have been reported where women with each pregnancy were in a state of mental apathy, drowsiness, and delayed cerebration, thought to be due to deficiency of the thyroid secretion. The myxedema does not usually increase during pregnancy, and other complications do not appear.

Treatment.—The indications are plainly for the administration of **thyroid gland**, which should be given at first in very small doses and then gradually increased. The **induction of premature labor** must be considered when the disease recurs with later pregnancies. The **patient** should be **warned against** further attempts at **childbearing**.

TETANY.—Tetany in pregnancy has, in a number of cases, been accompanied by symptoms of osteomalacia. By some this complication of pregnancy is said to depend upon the seasons and locality, being more frequent in the first four months of the year and in certain districts and countries. Tetany usually appears during the later months of pregnancy and may persist through lactation. Recurrence in subsequent pregnancies is common.

Symptoms.—The patient has painful and characteristic intermittent contractions beginning in the muscles of the extremities. A feeling of numbness, or a tingling in the parts to be affected, usually precedes the spasms, which are symmetrical. Each attack lasts from a few minutes to several hours. In severe cases the contractions are violent and are followed by marked exhaustion. Pregnancy is not shortened by tetany nor is labor affected. Though annoying, tetany is seldom dangerous, and recovery may be assured. It is important that *tetanus* and tetany be not confounded. In the former the spasm originates in the face and extends to the extremities; the back is also rigidly arched (*opisthotonos*); the contractions also persist and the mortality is high. *Hysteria* must also be excluded.

Treatment.—The remedies found most useful are **thyroid gland**, the **iodides**, **chloral**, **opium** and **chloretone**. **Inhalations of chloroform** may be required during the height of the spasms. **Massage** of the affected parts has a tendency to relieve.

LYMPHADENOMA.—Lymphadenoma, or Hodgkin's disease, may arise during pregnancy, or may antedate it. In the latter case the disease runs a more rapid course, and death may ensue in the latter half of pregnancy or soon thereafter.

Symptoms.—The glands in the neck usually become swollen on one side. Later, other groups of glands are involved; the axillary, bronchial, and mediastinal glands suffer enlargement, as does the spleen and, not infrequently, the liver. Pressure on the bronchi and veins produces a paroxysmal cough, edema, and ascites. Anemia, fever, and emaciation are present. Abortion commonly takes place and the anemia causes retroplacental and post-partum hemorrhage. The disease does not affect the child in any way.

Treatment.—If the disease is localized in the neck, **excision of the glands** may be performed. If the disease is more generalized, excision is useless. The internal use of **arsenic** has proved curative in some cases. The **uterus** should be **evacuated** in all cases.

ADDISON'S DISEASE.—Addison's disease as a complication of pregnancy is very rare. The disease in all the reported cases (3) has appeared during the pregnancy; labor was normal, but death from excessive vomiting and collapse occurred about eleven days after parturition. Immediate **induction of labor** would be in-

dicated if a woman having Addison's disease became pregnant.

HEMORRHOIDS.—These cause great annoyance, especially in the later months of pregnancy. It may be regarded as similar in its causation with edema of the vulva, and, indeed, may accompany it. It is more frequent with those who have suffered with the same trouble prior to pregnancy than with others; it is common with those who suffer with constipation, and is a source of great pain when the bowels are moved.

Treatment.—The measures indicated in the article on HEMORRHOIDS (*q. v.*) apply in the present connection, but, as a rule, surgical measures are only required when the hemorrhoids are very large and pediculated or are the source of unusual pain and discomfort. **Rest in bed** and the use of **astringent and sedative lotions**, such as have already been mentioned; careful and **thorough cleansing** of the parts, and the careful **regulation of the bowels** with mild aperients such as **confection of senna**, **cascara sagrada**, or **compound liquorice powder** (aloes and other remedies acting on the lower bowel are strongly contraindicated), will usually bring relief. For cleansing purposes a soft sponge should be used instead of the ordinary toilet paper. If the **hemorrhoids** prolapse they should be immediately **replaced** within the inner sphincter and the parts bathed with a cool solution of **boric acid**; if the prolapsed masses are large the application of a 10 per cent. **cocaine solution** and thorough inunction with an ointment containing **cocaine and adrenalin** will facilitate their return. Sitting at stool favors relaxation of the bowel, and

should be avoided, the patient standing or lying down. **Rest in the recumbent position**, with the hips elevated, for five or ten minutes after the bowels are moved, favors the emptying of the hemorrhoidal veins. If the hemorrhoids become inflamed, **rest in bed** and frequent **warm boric acid fomentations** will soothe the parts. This may, however, only be temporary, the permanent relief being postponed until pregnancy has terminated and the pressure and congestion have disappeared. (See HEMORRHOIDS, vol. iii.)

UTERINE PAIN.—Uterine pain may be due to a rigid and unyielding condition of the tissues of the organ, the pressure of contiguous viscera, emotions of various kinds, the movements and pressure of the fetus, traumatism from without, etc. The pain may be sharp or prolonged and aching, and is due to the contraction of the muscular fibers of the uterus. It may recur at frequent intervals, and if it should continue for a period of several hours it would result in the emptying of the organ.

Treatment.—This consists of **rest**, the **horizontal position**, and an occasional hypodermic of morphine (**morphine sulphate**, $\frac{1}{8}$ grain—0.008 Gm.; **atropine sulphate**, $\frac{1}{120}$ grain—0.0005 Gm.), given only when pain is severe, may be used for its relief. The pain may be so evanescent that no treatment will be required other than the avoidance of its cause, if that can be discovered.

SPURIOUS PREGNANCY.

Spurious pregnancy, or pseudocyesis, deserves consideration because the physician should always be prepared to distinguish it from true

pregnancy. Spurious pregnancy originates generally in a desire to become pregnant, which may become an intense yearning. It depends principally upon the presence of an abdominal tumor which may undergo enlargement suggestive of the gravid womb. Symptoms of true pregnancy may be present, including the “morning sickness” and the violet discoloration of the mucous membrane of the vagina, which is due to impaired or disturbed circulation the same as in uterogestation. The tumor may be uterine or extra-uterine, ectopic pregnancy being excluded. Of the extra-uterine tumors the simplest form is due to the presence of gas in the bowels. Strange as it may seem, this may persist for weeks and delude the patient completely. This “phantom tumor” is not uncommon and its sudden collapse is likely to cause the greatest surprise, if not disappointment. The other simulative form of extra-uterine tumor consists in the various types of cysts or solid growths, especially those of the ovary. These tumors sometimes grow very rapidly, this being especially true of the malignant tumors of the abdomen. In the early days of ovariectomy unmarried women were repeatedly accused of pregnancy when suffering with ovarian cysts. Not infrequently an ovarian or other form of abdominal tumor develops coincidently with uterogestation.

Tumors of the uterus which simulate pregnancy are principally of two forms: those which are due to the presence of fluid and those which are due to the presence of gas. Rarer forms: those which are due to the so-called molar pregnancy, or hydati-

diform mole. Solid tumors (fibroids) of the uterus develop so slowly that they are seldom mistaken for pregnancy, though the contour of the fibroid uterus is often very suggestive of gestation. *Molar pregnancy* is, in reality, a myxomatous tumor due to proliferative degeneration of chorionic villi. It is formed usually in the first, but not later than the third, month of pregnancy. Beginning as a true pregnancy, the fetus dies early in its history and is absorbed. Cysts of varying size, from a small seed to a walnut, filled with a mucous fluid, are formed in great numbers and are occasionally detached.

Abortion may occur prior to the sixth month or the condition may go to term or even longer and require surgical interference. Death from hemorrhage is one of the dangers which is to be apprehended.

In hydatid tumors of the uterus, which are extremely rare, the diagnosis depends, of course, upon the actual presence of acephalocysts or their hooklets. The cystic tumors in molar pregnancy are suggestive of acephalocysts; hence the term hydatidiform mole.

When the uterus is enlarged by a collection of fluid or gas the condition is known as hydrometra (a collection of more or less watery fluid), pyometra (a collection of purulent fluid), hematometra (a collection of blood), and physometra (a collection of gas). They must not be confused with those cases in which there is disease of the decidua, the amnion, or the placenta, and in which true, and not spurious, pregnancy is present. They are all conditions in which infection is probable.

Enlargement of the uterus from the retention of menstrual fluid might also be regarded as simulative of pregnancy and is not very rare. It occurs principally in young unmarried women. In all of these cases of uterine enlargement the indication is to **empty the uterus**, and usually it will be proper to follow this procedure with **irrigation and curettage**. The latter operation must be performed with caution and discrimination, and in most cases a light **tampon** should be introduced into the organ and retained two or three days.

Cases diagnosticated as pseudo-pregnancies, in which but one proved to be a true pregnancy. The patients were treated with ovarian organotherapy, which, in the non-pregnant women, brought on the menses. Sardou (*Presse méd.*, Aug. 17, 1910).

CONCEALED PREGNANCY.

In this condition, true pregnancy is concealed by some other more palpable and demonstrable condition; such as a solid or fluid tumor of the pelvis and abdomen. Such tumors may exist and have been discovered prior to the pregnancy. In cystic tumors pregnancy may occur and perhaps continue to term, but the latter may not be discovered until it is far advanced. With solid tumors, especially those which involve the structure of the uterus, the resistance is greater and pregnancy is usually interrupted or at least interfered with before it has progressed very far. In some cases delivery at term becomes impossible by the ordinary channel, and an **abortion** must be **induced**, the **tumor** must be **removed**, or else it may be necessary to **remove the fetus through an abdominal incision**. Concealed pregnancy may,

therefore, be a most undesirable complication. Rarely pregnancy takes place under normal conditions and the situation is not suspected until a late period. The menses appear at regular intervals, the abdomen does not show the usual symmetrical enlargement, and for various reasons the woman does not realize that pregnancy is present. Of course, the only treatment which is indicated is the expectant one, the pregnancy being allowed to continue to term.

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PREGNANCY AND PARTURITION (CONTINUED).

B. PARTURITION.

DISORDERS OF PARTURITION.—Neglect of a thorough examination of the patient months before the expected event occurs causes the obstetrician to be unprepared until the labor sets in, and, at times, to encounter complications which might have been avoided or checked had he undertaken prophylactic measures. Careful examination of the size and conformation of the maternal pelvis, to ascertain whether there is a disproportion between the bony structures and fetal head, is another measure which tends to reduce the mortality of both mother and fetus.

The recognizable causes of dystocia may be *maternal* or *fetal*.

MATERNAL CAUSES.—These may be subdivided into general and local predisposing factors. Any constitutional vice, whether acute or chronic, predisposes to anomalies of the expulsive forces, occasionally resulting in precipitate labor, but more often in protracted labor. Tuberculosis, organic heart disease, malaria, acute diseases—

such as pneumonia, nephritis—with the possibility of eclampsia, represent the *general* maternal causes most frequently encountered. The *local* maternal causes are of even greater importance, and consist of tumors, uterine or extra-uterine; pelvic deformities, including bony tumors, generally contracted and flat rachitic pelvis, simple flat pelvis, and irregular pelvis; spasm or rigidity of cervix or abnormalities or tumors of the same; uterine malformations, either congenital or acquired; hematoma of the genital tract; spasm, rigidity, or abnormality of the vulva or perineum; full bladder or rectum; placenta previa; uterine rupture or inversion; intrapartum and postpartum hemorrhage, and retention of the placenta and membranes.

When the uterine muscle shows feebleness in the beginning of labor and during dilatation, this condition of atony is called primary uterine inertia. It may be due either to anatomical changes in the uterine muscle or to disturbed innervation. Secondary inertia is a condition of exhaustion which, from various causes, comes on during the period of expulsion. Before rupture of the membranes, in primary inertia, there is no indication for active intervention. After rupture, if there is danger to life of the child from the discharge of liquor amnii, or the mother's life is imperiled from danger of septic infection, **dilatation** should be brought about by the metreurynter (rubber bag), and **forceps** or **version** followed by **extraction** then employed. In secondary inertia a too protracted labor is dangerous to the mother and child, and active intervention is indicated; if the head is well down in the pelvis, the **forceps** should be applied. It has recently been proposed to perform **Cesarean** section, but there is no indication for such operative procedure in inertia *per se*. In

primary inertia a combination of **morphine, atropine, and strychnine** often has an excellent effect when given hypodermically. After dilatation **pituitary gland** has found favor with some obstetricians. G. T. Harrison (N. Y. Med. Jour., July 19, 1913).

Tumors.—*Fibroid tumor* of the uterus is so frequent as a complication of pregnancy that this is often considered of little importance. So long as the growth does not obstruct the pelvic inlet it may give rise to no trouble except possibly to predispose to hemorrhage in the third stage of labor. Fortunately, fibroids are mostly situated at the fundus and are out of harm's way; or, being pedunculated, even though encroaching so as materially to interfere with labor by occluding or narrowing the pelvic inlet, in most cases they can be pushed up beyond the presenting part. The difficult cases are those in which large growths springing from the lower uterine wall or intraligamentous fibromata form an insurmountable barrier to delivery.

The next most frequent obstructive tumor is the *ovarian cystoma*. Peculiar as it may seem, small growths are more apt to cause dystocia than the greater ones. While patients with enormous cystomata rarely become pregnant, if this obtains, the cyst may frequently be pushed out of harm's way. The smaller varieties—dermoids, for instance—are likely to become incarcerated and so wedged in Douglas's *cul-de-sac* as to make the possibility of terminating labor by the ordinary passage practically impossible. Again, the possibility of rupture of such a tumor is not remote.

Carcinoma of the cervix is a somewhat rare complication. Early in the course of the affection the complication

is not an alarming one, since the first stage of labor is rarely influenced. It is only during the ulcerative stage that the hemorrhages, sloughing, etc., make the complication a very trying one.

Histories of 9 cases of tumors of the ovary complicating pregnancy and labor which occurred in 42,000 labors at the Lying-in Hospital, New York City. The writer's conclusions as to treatment are as follows: Inasmuch as the maternal mortality of cases during pregnancy ranges between 20 per cent. and 25 per cent. when no operation is performed, as against 3 per cent. to 5 per cent. in operative cases, **abdominal ovariectomy** should always be done as soon as the diagnosis is made. If the tumor does not descend into the pelvis during labor, it requires no treatment at this time. If the tumor is found to lie in the pelvis at the time of labor, endeavor to push it up gently into the false pelvis. If this cannot be done and the child is alive, the writer resorts to a **vaginal ovariectomy** with subsequent **delivery of the child**, or a **Cesarean section* with ovariectomy**, or an **abdominal ovariectomy, with delivery "per vaginam."** If, however, the tumor descends into the pelvis during labor and the child is dead, it may be possible to do a **craniotomy and extraction**. In some of these cases, however, **ovariectomy** must be first performed. If the tumor was not removed either during pregnancy or labor, it will probably give trouble in the early puerperium. Therefore, operation soon after delivery is indicated in such cases. R. W. Lobenstein (Bull. of Lying-in Hospital of City of New York, Sept., 1907).

In the presence of a tumor we should remember that we have 2 patients with 1 tumor and 1 patient with 2 tumors. In a series of 114 cases collected by the author, 76 were operated for **removal of the tumor** during pregnancy previous to

*Procedure recommended by the author.

full term; 73 mothers recovered and 63 mothers went on to term. Thirty-eight cases were unoperated before term. At term the mortality is higher from operation, being in the ratio of 18.4 per cent. as compared with 2.6 per cent. in cases operated before term. The most favorable results are to be found in cases operated upon during the first half of pregnancy. C. W. Barrett (Surg., Gynec. and Obstet., Jan., 1913).

Pelvic Deformities.—Pelvic deformities are comparatively rare in this country. Relative pelvic contraction—*i.e.*, a pelvis of average size which is yet too small to admit of the passage of an overlarge child—however, is common enough. In truth, there is no pelvis, except one very much contracted in one or all diameters, which cannot act naturally and without assistance as the passage-way for the fetus. A pelvis can only be said to be contracted when a particular head cannot adapt itself to that particular pelvis. This cannot be measured absolutely; it can, however, be intelligently estimated. A good rule in midwifery is the following: Any head, no matter how large, which can adapt or engage itself in a pelvis, no matter how small, can safely pass through the pelvis. The chief exception is the funnel-shaped pelvis, which, in high degrees, is exceedingly rare. A pelvis with normal or supernormal measurements can be as contracted for the passage of a large unyielding head and cause the same interference, as a pelvis whose size is estimated as small or much below the normal; or, on the other hand, a very decided degree of pelvic contraction or distortion is no barrier to the passage of a sufficiently small child at term.

In Hofmeier's service there were 526 cases of delivery with narrow pelves, including 27.9 per cent. pri-

miparas. The total fetal mortality was 10.2 per cent.; the maternal, 0.57 per cent. Premature delivery was induced in 63 cases. All women with contracted pelves should be sent to a hospital at least on the inception of labor. The narrow pelvis cases formed 5.26 per cent. of the last 10,000 deliveries. The women were delivered by **Cesarean section** in 17.1 per cent. of the 526 cases, and by **pubiotomy** in 4 instances, but such operations have been abandoned since 1909. The degree of contraction of the pelvis averages high at this clinic (Würzburg), the conjugate diameter measuring from 5.5 to 7.5 cm. in 23.3 per cent.; from 7.6 to 8.5 cm. in 52.7 per cent., and from 8.6 to 10 cm. in 24.1 per cent. Schmitt (Zeit. f. Geburtsh. u. Gynäk., Apr. 5, 1921).

The *unknown* elements in all these cases are, first, the size of the child's head and its condition, and, second, the force and vigor of the uterine action. To measure the size of the unborn fetal head, even at the present day, we must rely solely upon an estimate obtained by external means, including the adaptability of the head to its own particular passage-way. Yet the pelvimeter and pelvimetry afford a degree of information that it is not our intention to overlook. Thus, narrowing of one or more of the pelvic diameters should always make us suspicious and apprehensive as to the outcome and inspire unusual care in watching the progress of such a case. But never because of a pelvic contraction, except possibly where the history of prior difficult and dangerous labors is obtainable months before the advent of labor, should the patient be advised to elect any operation, until the size of the fetal head, as compared to the size of the maternal pelvis, is ascertainable.

The generally contracted justminor pelvis is the most frequent form and is

more apt to give rise to difficult labor than either the simple flat or the flat rachitic pelvis, because of the narrowing in all diameters and the absence of a compensatory enlargement. Where compensatory enlargement occurs in one or another of the diameters, as in a flat pelvis, nature seems to find this wider path to force the well-flexed head through, and studiously avoids the narrowest (most frequently the anteroposterior or oblique), the transverse, as a rule, being the compensatory diameter.

In typical funnel pelvises the distance between the tubera ischii is reduced to 8 cm. [11 cm. normal] or less, the usual measurement remaining unchanged. Such pelvises were noted in 6.1 per cent. of 2215 full-term labors, equally in white and black women, and may cause serious dystocia. This abnormality includes 44 per cent. of all deformed pelvises in white women. In colored women it is fourth in frequency. The prognosis depends mainly upon the relation between the tubera ischii and the posterior sagittal diameter. Moderate dystocia can often be overcome by placing the patient in an **exaggerated lithotomy** or **exaggerated Sims position**. This will increase the anteroposterior and posterior sagittal diameters by an average of 1.62 cm., which may permit spontaneous labor. This enlargement explains the successful result of certain low forceps operations, which would seem impossible from the measurements in the ordinary position: **Pubiotomy** is the operation of choice in pronounced dystocia, as it both permits the delivery of the child and leads to permanent increase in the size of the outlet, the latter being further enlarged by the softening of the fibrous union under the influence of the hyperemia of pregnancy. The spontaneous termination of subsequent labors is thus made possible. Williams (*Amer. Jour. of Obstet.*, July, 1911).

In primiparæ having contracted pelvises, where the pelvis has sufficient capacity to permit the child's head to enter, the head is usually deep in the pelvis at the end of pregnancy. This often develops as early as six weeks before the beginning of labor. Actual expulsion of the child is then frequently rapid. The cranial bones are pressed under each other less than in some other cases. An exact mold of the fetal head soon after birth gives an accurate reproduction of the pelvic cavity. Walcher (*Zentralbl. f. Gynäk.*, Nu. 22, 1914).

Resection of the promontory for contracted pelvis, proposed by Rotter and Schmid, has been done in 24 recorded cases. Four of the women died, and 4 had grave infection. This mortality of 16.5 per cent. is higher than with even repeated Cesarean section. Only 1 of the women had another pregnancy later, so that the operation proved superfluous in all the others. Cathala and Perrot (*Revue Franç. de Gynéc. et d'Obstét.*, Feb., 1921).

Spasm or Rigidity or Other Abnormalities of the Cervix.—These are potent and frequent causes of dystocia, their tendency being to very materially prolong the first stage of labor. The spasm of the cervix may be due to reflex conditions, such as malpositions of the fetus, but a most frequent cause is a general neurotic state of the patient. The pains existing are very severe and lasting, while no material progress takes place in the cervical dilatation.

The diagnosis is positive if, on examination, the edges of the os are found very rigid, but thin, having a razor-like edge, very hot, extremely painful, and tightly hugging the head.

Rigidity of the cervix is, as a rule, the result of previous cervical lacerations or of a prior existing chronic cervical endometritis, both conditions

producing more or less marked cicatrizations of the cervix.

Spasmodic rigidity of the cervix produced by **ergot**, with consecutive retention of the placenta, in a 23-year-old primipara, seen by the writer. Fifty centigrams ($7\frac{1}{2}$ grains) of ergot increased the pain and was followed by expulsion of the child. As the secundines failed to appear, a second dose was administered. The second dose produced a uterine spasm so intense that the administration of chloroform was necessary before manual detachment of the adherent placenta could be effected. Even though every precaution was taken, puerperal infection developed and lasted 3 weeks. The possibility of such effects of ergot on primiparæ renders the use of forceps more desirable. B. Garriga (*Arch. de gynec., obst. y pediat.*, xxiv, 65, 1921).

Malformations of the Uterus.—Bicornate uterus and other congenital malformations, as well as acquired states of the vagina, give, as a rule, very little trouble during labor, since the patient either aborts early or, if pregnancy advances to full term, nature takes care of the malformations.

Occasionally a congenitally deformed uterus ruptures at term, but this complication is rather as much an accident as though it occurred in a normal uterus.

Pathologically deflected uteri, the result of a prior existing pelvic peritonitis, are seldom causes of dystocia at term. If the pathological condition is extreme, these patients seldom become pregnant normally, and are more likely to be the victims of an ectopic pregnancy. If the adhesions which bind the uterus in a false position are not too old, the growing uterus will stretch them sufficiently to allow that organ to assume its normal position. If not, abortion is the usual result.

[In instances of this nature, the woman being exceedingly anxious for offspring, the possibility of avoiding abortion by operative separation of the adhesions is justifiable in view of the slight risk.]

Tumors of the lower genital tract, including hematoma, are rare complications, and yet when they do occur may produce very alarming conditions.

Spasm, Rigidity, or Other Abnormality of the Vulva or Perineum.—

Predisposition to these conditions attends those that are too young, in whom the parts are undeveloped and unyielding, or, on the other hand, those in whom spastic contractions of the sphincter ani exist. They are also apt to occur in women who conceive late in life, whose genital tract is tense and resisting. In another class, in which, occasionally, previous lacerations give rise to firm cicatrices, an almost absolute barrier is offered, which can only be overcome by radical measures such as episiotomy.

Full Bladder and Rectum.—These conditions constitute a most prolific cause of difficult and prolonged labors. One would suppose that a normal bladder would functionate spontaneously, but this is not always the case. By disturbing the axial relation between fetus and pelvis, owing to displacement of the uterus by an overdistended viscus, grave and marked symptoms may arise. These, however, can be readily arrested as soon as the cause is discovered. With equal force can an overdistended colon and clogged rectum produce the same disturbance.

Posture of the Patient After Labor.—For a few hours after labor, a patient should be kept in the recumbent horizontal position. After recovering from any exhaustion, she should be placed in

a modified Fowler position, the shoulders several inches higher than the pelvis, allowing her to turn from side to side, and encouraging her to turn upon the face in the prone position. Thus is drainage of the birth-canal promoted. The author believes that every puerpera would be the better for remaining absolutely in bed for two weeks. Within this time, aided by good **hygiene**, **general massage**, **occasional assumption of the knee-chest position** toward the end, and the administration of **strychnine** and **ergot**, the lochia usually will have ceased and involution of the uterus and other structures will have progressed well. With the present notions of the laity, however, it is usually impracticable to keep the patient in bed more than ten days. She is then soon excessively on her feet, often with resulting prolonged subinvolution, metrorrhagia, and uterine displacements.

Retention of Placenta and Membranes, Intrapartum or Postpartum Hemorrhage, Inversion of the Uterus, and Rupture of the Uterus are accidents or complications of labor that should seldom occur, and which are usually due to mismanagement or carelessness on the part of the obstetrician. Proper skill and vigilance will usually avoid them.

Fragments of placenta are often retained in the uterine cavity for a considerable time. They are sometimes considered benign tumors, capable of assuming malignant characteristics. The writers believe that a change from placental tissue to chorionic epithelioma is altogether exceptional, and so far has not been proved. A placental polyp should not be considered a benign tumor, for it does not grow by the proliferation of its own elements which extend into adjacent tissue as tumors usually do. The best concep-

tion of the retained placenta is that it is a sort of graft which may continue to survive occasionally for a long time through the maternal circulation, and which in the end is either absorbed or eliminated. The accumulation and organization of clotted blood produces the apparent increase in the size of this region, and this is comparable to a thrombosis which grows along the blood-vessel. These prolonged retentions of placental tissue constitute residue with a precarious life, having only a transient existence in the organ harboring them. Lencane and Promsy (*Ann. de gynéc. et d'obstét.*, Oct., 1919).

Retention of the placenta and membranes, as a whole, is often more apparent than real. With proper patience, in the absence of undue hemorrhage, simple manipulation will very rarely fail in their final expulsion. Coincident with fetal expulsion, a hand on the abdominal wall should follow the fundus of the uterus down to see that there is moderate contraction of the organ. The uterus should thus be guarded, to note that it is not relaxed, this usually being overcome by moderate compression. On the other hand, no undue manipulation should be used, lest the placenta be separated before the tired muscle has regained its tone and time has elapsed for thrombi to form in the uterine sinuses. Preferably a half-hour should elapse before placental separation. Meanwhile, perhaps, separation has occurred, indicated by the hardening of the uterine body and the moderate "rising up" or anteversion of the organ. On such indication Credé's method of grasping the uterus with the whole hand—the thumb posterior, the fingers anterior—and making firm compression and pressure downwards may properly be used to assist the natural forces of the patient in expelling the

after-birth from the cervix and vagina. Haste should be made slowly at this stage, receiving the placenta in the hand and gently revolving it, twisting the after-coming membranes to avoid tearing them and leaving portions behind.

If, after half an hour, there is no sign of placental separation, moderate Credé manipulation will very generally stimulate the uterus to the necessary contraction. If at first not successful, the procedure should be repeated at intervals for at least two hours. Meanwhile, a hypodermic injection of a dose of **pituitary body** may aid materially. Ergot should never be given at this stage. Its injudicious use may have been the active cause of locking up the after-birth.

Not a few good obstetricians would pursue the expectant plan for many hours rather than introduce the hand into the uterus for manual removal of the secundines. The author believes, however, that if, after two hours, the means outlined above are unsuccessful, it is for the best interest of the patient gently to extract the after-birth with the carefully sterilized and disinfected, gloved hand in the uterus. This should not be undertaken lightly, and the grave danger of septic infection should be avoided with the utmost care as to surgical cleanliness. The whole of the after-birth should be secured in the palm of the hand before removal of the latter, so that there may be no necessity for its reintroduction. No other intra-uterine manipulation is such a menace as regards infection.

The writer injects 300 to 500 c.c. ($\frac{3}{5}$ to 1 pint) of **saline solution** or plain **boiled water** through the umbilical vein into the placenta when the latter is retained and there are hemorrhages. He finds this method quite efficient, although it may need to be repeated several times. The

fluid distends the placenta, renders it heavier, alters its shape, and tends to detach it. The turgidity of the placenta acts as an irritant to the uterus, which contracts and helps expel it. E. Frey-Bolli (Corresp. Blatt f. schweizer Aerzte, Apr. 19, 1919).

The writer injected **salt solution** into the placenta in 30 hospital cases. The placenta was expelled spontaneously in 3 to 5 minutes. In a few instances the Credé method had also to be used, because of imperfections in technique. The cannula used should have a circumference of 1.5 cm. and a groove behind the lumen to prevent slipping of the cord when attached to it. Fifteen or 20 Gm. ($3\frac{3}{4}$ or 5 drams) of salt are added to 1500 c.c. (3 pints) of sterilized **hot water** (temperature 50° to 60° C.). Swelling of the arteries proves that the injection has been successful. As soon as 200 c.c. of solution is injected, detachment of the placenta begins. To prevent formation of clots the writer adds 2 per cent. **sodium nitrate** to the solution. Sklayounos (Surg., Gynec. and Obstet., Feb., 1920).

Postpartum hemorrhage, so-called, is often intrapartum, beginning before the completion of the third stage, frequently soon following the third stage, rarely beginning an hour or more subsequent to the completion of labor. The proper management of the third stage, as indicated above, will very generally secure against such a serious result. In a maternity service with which the author was connected for years, it was a routine custom to have a nurse who was well trained in the technique, to guard the uterus with a hand on the abdomen for the first hour of the puerperium. On any tendency to relaxation of the uterus it was kneaded and grasped firmly. No serious hemorrhage ever occurred. I would that such could be the routine treatment of every case.

We should be on special guard in certain cases of abnormal labor—prolonged exhausting labor, precipitate labor, cases of undue distention, placenta previa, or neoplasms complicating. Withal, much depends upon the skillful management of the third stage. Unfortunately, the placenta sometimes becomes detached, either partially or completely, too soon following fetal expulsion, hemorrhage ensuing. If, upon gentle manipulation, the bleeding does not cease, it is imperative to proceed and promptly to secure placental expulsion and firm uterine contraction. An empty uterus firmly contracted cannot bleed excessively from the placental site. Severe hemorrhage under such conditions can usually be located in tears of the genital outlet or cervix.

Routine administration of **ergot** with **strychnine** immediately following placental expulsion is an excellent prophylactic. A preparation of ergot for hypodermic use should always be available. A good dose of the **pituitary** preparations, in addition, is excellent. Usually measures outside the birth tract, such as indicated, having excluded cervical and vulvo-vaginal tears, will successfully prevent or control postpartum hemorrhage. A **vaginal douche** of sterile fluid at a temperature of 115°-120° F. will often stimulate uterine contraction. If not successful, an **intrauterine douche** will likely be effective. In persistent or alarmingly severe cases, firm **packing** of the **uterus** with sterile gauze is the only means of assured success. The author has several times been very successful in such cases with **Breisky's method** of **bimanual compression**, with the fingers of one hand pressing through the abdominal wall upon the posterior surface of the uterus, two fingers of

the other hand introduced into the anterior vaginal fornix pressing against the anterior uterine wall. The uterus is thus firmly grasped, compressed and somewhat anteflexed. The aorta may be compressed at the same time.

Placenta Previa and Abruptio Placentæ.—Two placental conditions not infrequently resulting in the gravest intrapartum hemorrhage are *placenta previa*, low attachment of the placenta, and *abruptio placentæ*, premature detachment of a normally situated placenta. The problem, alike in both, is to minimize the hemorrhage until the uterus is emptied, to combat postpartum hemorrhage, and to relieve the anemia.

Placenta previa is usually characterized by genital bleeding in the latter months of pregnancy, the hemorrhage occurring without apparent cause and without painful uterine contractions. The positive diagnosis is made only by palpating a portion of the placenta through the cervical canal. Such a diagnosis made, the indication is to empty the uterus without delay. "There is no expectant plan of treatment." The only exception permissible is that with the child near viability, the patient bleeding slightly, having her in bed in a properly equipped hospital, we may occasionally await the viable period before inducing labor.

Labor having been induced by an approved method or the process having begun spontaneously, the obstetrician should be in constant attendance. Skill and facilities should be at hand to meet any emergency. If the case be one of lateral or marginal placental attachment, the bleeding may be but a little more free than that of normal labor, and it may be sufficient that the case be attended as one of normal spontaneous delivery, meanwhile watching with

all vigilance, ready to act on a moment's warning. Early **puncture of the membranes**, securing pressure of the head on the placental site, may serve to lessen the hemorrhage.

Cases of complete or even of partial placenta previa sometimes are best treated by most radical means. With the cervix tightly closed and firm, the bleeding frank, and the child in good condition near term, abdominal **Cesarean section** should be the elective procedure. Such a condition would rarely exist except in a primipara. With a soft dilating cervix and efficient pains, firm **intracervical** and **vaginal packing**, removed in twelve hours or less, may minimize the bleeding while cervical dilatation progresses. Meanwhile, a very firm abdominal **binder** (Spanish windlass variety recommended) should supply counterpressure. On removal of the gauze, if no active bleeding appears, watchful expectancy may be the plan. Renewal of the packing may be indicated. By such procedure, the attendant may be rewarded by an engaged fetal head coming through a dilated cervix. The first stage of labor thus having been successfully completed, it is usually to the interest of the child, and not detrimental to the maternal interests, to deliver promptly with forceps.

Fever is an absolute contraindication to Cesarean section. When the woman has bled a great deal at the beginning of labor, it is important to spare her further hemorrhage, and Cesarean section is called for, unless the tissues are elastic and dilatation far advanced. "With total placenta previa, operate; with partial, refrain." With the death of the fetus there is less reason for operating. C. Thélin (*Revue Méd. de la Suisse Romande*, Feb., 1921).

Two other means of assistance are always to be kept in mind, and should be available resources, namely, **podalic version** and the **metreurynter**. In using the former, the life of the child must be practically ignored, the thighs and buttocks of the fetus being used as a tampon to staunch the hemorrhage. In the central variety, this method is often imperative, the operator having to break through the placenta to secure a foot. Such manipulation, done early, must be by the **Braxton-Hicks method**. With the cervix dilated sufficiently to admit two fingers, the membranes are punctured or the placenta bored through. The fingers gently push the head upwards and to one side, the external hand pushing down the breech, then a foot, in the direction of the inside fingers. Complete relaxation of the patient, perhaps by brief anesthesia, is essential to the maneuver. A foot having been grasped, it is carefully drawn down into the vagina, the external hand pushing up the fetal head. Version having been completed, moderate traction upon the leg of the fetus will effectively tampon the cervix and lower uterine segment. There should now be no fear of immediate undue loss of blood.

In the 257 cases at the Vienna clinic in the last 9 years (24,678 deliveries), the rule has been to apply **combined bipolar version** when the condition calls for immediate hemostasis, regardless of whether the child is viable or not. Delivery followed within 20 minutes in the 43 cases in which this was done with the os dilated for 2 fingers or more. The mortality of the probably viable children was 38 per cent., and 6.9 per cent. of the mothers succumbed, but the loss of blood before the woman reached the clinic was responsible for these fatalities. The combined **Braxton-**

Hicks version is too often credited with the deaths for which the pre-existing exsanguinated condition is responsible. It was applied in 41 per cent. of all the placenta previa cases, and the maternal mortality was 3.8 per cent. The **inflatable bag** was used in 35 cases, the cervix admitting only the finger, and 52.4 per cent. of the children were born alive and none of the women died. Hiess (*Monats. f. Geb. u. Gynäk.*, Mar., 1921).

The mistake should not be made of now hastening delivery by breech extraction. Wait until the patient partly reacts, meanwhile securing complete dilatation of the cervix. Observance of the latter may be the means of saving the life of the mother.

The **metreurynter** or **hydrostatic bag** is a valuable help in many cases. Every obstetrician should be provided with a set in graded sizes (Voorhees type), conical in shape, flat top. For general technique, see *Induction of Labor*, page 649. One special point in technique must be carefully observed when the bag is used in placenta previa, namely, that the membranes must be ruptured and the bag be introduced inside the amniotic sac above the placenta, so that the pressure exerted by it is upon the placenta from above downward. During the interim between the uterine pains, moderate traction, not to exceed one or two pounds, should be made on the tube connected to the bag—no traction during the pains. In this way, the hydrostatic bag simulates the natural dilatation by the amniotic sac, and by constant firm pressure acts as a tampon to control bleeding. By this method, the chances of saving the child are increased. When a bag sufficient in size to accomplish complete or almost complete dilatation passes from the cervix, it is of the

utmost importance to be prepared to act promptly. Sometimes the head enters the cervix and pelvis promptly as the bag passes, and in such cases the attendant may, with greatest advantage to all, await nature's lead. When the head passes through the cervix, it is best to deliver promptly with **forceps**. If the head cannot be brought down into the cervix, prompt **podalic version** and subsequent **breech extraction** are the procedures.

In over 2000 cases of placenta previa collected from various sources, the maternal mortality was 7.7 per cent., with a high morbidity; the fetal mortality was 61.5 per cent.

In cases of placenta previa in which the bleeding begins before labor, the interests of the child demand expectant treatment, viz., **absolute rest** and sedatives. If, after sedative treatment, hemorrhage recurs before labor has started, or if there is a single profuse hemorrhage, active measures are indicated at once. In every case of placenta previa and accidental hemorrhage the strictest precautions for asepsis must be taken. **Cesarean section** is indicated: (1) In primigravidae and others with sufficient pelvic obstruction to prolong labor seriously. (2) In cases of rigid and undilatable cervix in which the indications suggest prolonged labor. (3) In most cases of placenta previa centralis and placenta previa complicated in eclampsia. M. J. Jensen (*Journal-Lancet*, xxxix, 197, 1919).

The writer advocates the extra-ovular introduction of the **elastic bag** for the arrest of hemorrhage. The patient's condition must be carefully watched. If the bleeding reappears an immediate examination is necessary because such bleeding usually indicates the expulsion of the bag. In many instances of incomplete placenta previa rupture of the membranes occurs spontaneously about this time and the presenting part en-

gages and descends. Bleeding may occur immediately after the delivery of the child. It is best to conserve the patient's strength as much as possible by immediate expression of the placenta followed by the injection of 1 or 2 c.cm. of **puitrin** or the administration of **ergot** by mouth if prompt uterine contraction does not result. C. W. Kosmak (Bull. Lying-in Hosp. N. Y., xii, 51, 1920).

Accidental hemorrhage (abruptio placentæ) or premature detachment of a normally situated placenta may be due to a fall, blow, kick, or other traumatism, or may occur independently of any such experience. The most important predisposing cause is decidual disease. Many cases are so mild as to escape notice, but severe types are grave and most difficult to deal with.

The diagnosis is based upon the symptoms and signs of acute abdominal pain on one side, sudden in onset, tense abdomen, absence of fetal heart sounds, generally external hemorrhage, with general symptoms of increasing anemia and shock.

The best treatment is that which empties the uterus in the quickest way with least danger to the mother, meantime controlling the hemorrhage, and afterwards relieving the anemia. The condition of the cervix guides in the method chosen. If dilated or readily dilatable manually, **forceps** or **version** may terminate the labor promptly. If the cervix is tightly closed, **abdominal Cesarean section** may be the wiser course.

The cervix being only slightly dilated and practically effaced, probably the best course is **puncture of the membranes**, introduction of a **hydrostatic bag**, **packing the vagina** very firmly, applying an abdominal **binder** with as much compression as the patient

will bear, and administration of **ergot** or **puitrin**, one or both, to stimulate uterine contraction. When dilatation is sufficient or can be completed manually (the cervix may have to be incised), the delivery can be done by forceps or version and extraction. If the hydrostatic bag is not used, the membranes should not be punctured early.

Inversion of the uterus, incomplete or complete, is a rare complication of labor and can usually be ascribed to mismanagement of the third stage. An abnormally short cord may predispose, or undue traction on the cord by the attendant or by delivery of the child when the patient is on her feet may cause it. The author has observed only one case. When anesthetizing for an obstetrician he noted that the Credé method was attempted, but perhaps unskillfully employed. Instead of the uterus being grasped in the hand, pressure was made with the fingers on the fundus, beginning an inversion, which uterine contraction quickly completed.

The treatment is prompt manual **reposition** of the uterus by taxis, after removal of the placenta. The fist of the operator should remain in the uterus until uterine contraction is in evidence and bleeding has largely ceased. If the latter is not readily secured, the uterus should be firmly packed.

Rupture of the uterus rarely occurs in good obstetric hands. It is chiefly due to obstructed labors. Even in cases of symptoms of threatened rupture this catastrophe may usually be averted by good judgment and prompt, skillful action.

The most frequent causes are disproportion between the fetus and pelvis, and abnormal presentations or positions, *e.g.*, shoulder and brow presentations. Tumors obstructing the pelvis, a dis-

eased uterine wall, or one the site of a previous Cesarean section, may predispose. The giving of ergot, intra-uterine manipulation, for example in version, and placenta previa are sometimes evident causes. A threatened rupture should usually have been anticipated and prevented. Probable disproportionate size of fetus and pelvis should have been determined during pregnancy and should have been anticipated by, perhaps, induction of labor before disproportion was actually reached; or, having given the test of labor at term, by substituting Cesarean section for a prolonged obstructed labor.

A restless, anxious patient complaining of intense pain, with accelerated pulse, strong—sometimes tetanic—uterine contractions, the upper segment thickened so as to show a palpable groove across the abdomen below the contraction ring—these signs should be sufficient to warn of impending danger of rupture. Immediate measures must relieve the condition. Relaxation should at once be secured by **ether** anesthesia and such procedures used as the case demands. Any internal manipulation must be done with the greatest caution. The child in good condition and the pelvis markedly contracted, **Cesarean section** should be done. There being no great disproportion and no obstruction by the soft parts that cannot be readily remedied, **forceps delivery** may be the choice. Nice judgment and best skill may be necessary in correcting malpresentations or positions. In shoulder presentation, the child in good condition, **version** may possibly be done under profound anesthesia. The child being dead, **embryotomy**, including **craniotomy**, are the means of relief.

The diagnosis of actual rupture is usually made by the symptoms and

signs of sudden excruciating pain, followed by collapse. Uterine contractions cease or are weak, there is an asymmetrical tumor of the abdomen, with perhaps tenderness. There is usually external bleeding, and internal examination perhaps reveals the fact that the presenting part has receded. The fingers may feel the uterine rent.

In such cases **delivery per vaginam**, if the rupture is not complete, may be practicable, uterine packing following. In complete rupture, and indeed in many other cases, the interests of the mother will best be conserved by **laparotomy**. In this procedure, the child having been removed, the surgical judgment of the operator must determine whether to **suture the uterus** or to perform **hysterectomy**.

In all cases of abnormal labor, special precautions must be taken against postpartum hemorrhage. (See Postpartum Hemorrhage.) In cases of excessive blood loss, all the approved means for relieving acute anemia should be availed of. This should include, in extreme cases, **blood transfusion**.

FETAL CAUSES.—The fact that the fetus causes dystocia either by being oversized or by presenting itself in a vicious position simplifies the lines of treatment very materially. A large, unyielding head attempting to pass through what is usually considered a normal pelvis produces such disproportion between the head and pelvis that the latter must be considered contracted so far as that particular head is concerned. If the head is unusually large or refuses to mold, we may be confronted with a condition which would warrant us in seriously considering a major operation in order to effect delivery. This same statement holds

equally good in an unrecognized vicious position of the fetus. The chief fetal causes of dystocia may be enumerated as follows: Too large a fetus, including partus serotinus; prematurity; multiple pregnancy; monsters; hydramnios or oligohydramnios; adhesion of membrane or decidua; thick membranes; malposition; malpresentation.

Abnormally Large or Small Fetus.—A fetus which is oversized has a decided influence in causing dystocia. The subject has been referred to elsewhere in this article. True partus serotinus is rare, but it undoubtedly does occasionally occur. Here the pregnancy is prolonged, the woman even carrying the fetus as long as eleven months. This is verified by the unusual size of the child, the long hair, and the long, firm finger-nails. Too small a fetus or one that is premature gives rise to complications, because it has a tendency to assume a vicious position.

The writer recommends the following measures to minimize the traumatism: 1. The **elimination of fats and carbohydrates** from the diet of the mother during the **last 6 weeks** of pregnancy to retard the full or overdevelopment of the fetus. In such cases the child will be from 1 to 2 pounds lighter and none the worse for it. 2. The **induction of labor 10 or 12 days before term** before much disproportion has been reached. 3. In cases of contracted pelvis and small fetal head the application of the **test of labor** followed by **instrumental delivery** if necessary. 4. The **test of labor** at term and emergency **Cesarean section** without instrumental interference when in doubt, and elective Cesarean section when there is no doubt, as to the possibility of delivery by the natural route. He holds, moreover, that the greater number of cranial injuries occur from the application of forceps to the head in a faulty position. When there is

doubt he advises that the position of the head be ascertained by the introduction of the gloved hand. Protracted labor does greater harm to the child in transit than the use of the forceps properly applied. J. C. Applegate (N. Y. Med. Jour., cix, 626, 1919).

Multiple Pregnancy.—Multiple pregnancy, because of overdistention of the uterus or, again, because malpositions in this case are the rule, is a frequent source of difficult labors.

Monsters.—Hydrocephalus, joined twins, congenital tumor, anacephalic monsters, either because of their size or their tendency to present pathologically, are nearly always the cause of difficult labors.

Hydramnios.—Hydramnios, by overdistention, acts similarly to multiple pregnancy, while the opposite condition, oligohydramnios, is frequently associated with grave malformations of the fetus. This, with the absence of the water-wedge to dilate the os, usually produces a very prolonged first stage.

Adhesions of the membranes or persistence of the decidua in the neighborhood of the internal os or very thick and resisting membranes, the result of a chronic deciduitis, is a causal factor which can produce as much trouble as an occlusion of the external os. Indeed, it often simulates the latter condition. Unless recognized and measures be taken to overcome the occlusion, it is not impossible for a uterine rupture to occur.

Malposition and Malpresentation.—Under this subdivision we have the most prolific causes of dystocia. The great danger lies chiefly in the fact that when a malposition rather than a malpresentation occurs it is sel-

dom recognized. We refer especially to occipitoposterior positions, than which no more troublesome complication arises. We emphasize the fact that a malposition of a normal presentation is possible. Similiar malpositions would include chin-posterior cases. The fault in the non-recognition of these cases always rests with the physician. Most examinations are perfunctory; the attendant rests satisfied so long as he feels the round, bony head, whether engaged or non-engaged.

Characteristic of all vicious positions and presentations are early rupture of membranes, slight nagging pains, and slow or absent engagement of the head. Non-engagement of the head generally means either a malpresentation or malposition or a relative or absolute pelvic contraction; in short, a pathological condition. The obstetrician might possibly err in failing to find a pelvic distortion or contraction; he must never fail, however, to clear up a malposition or malpresentation. If this is not possible by the ordinary means, he must insist upon the introduction of the whole gloved hand into the uterus to clear up the condition, although this requires anesthesia. It is evident, reasoning from practical experience, that, since highly contracted pelvis in this country are comparatively rare, the most frequent causes of dystocia can be ascribed to malpositions and malpresentations. Early recognition and timely interference as the case demands, operating then and there only when the indications present, are the secret of absolute success.

The profession recognizes that the common and most favorable conditions are universal flexion of the fetus, the

normal attitude; the head lowest in the birth-canal, and as a result of flexion of the head, in *vertex presentation*. The latter condition brings the two fontanelles and the sagittal suture as anatomic landmarks in internal examination, within the circumference of the birth-canal. Approximately 95 per cent. of all cases are in this relation. Moderate deflexion or extension of the head causes the unfavorable *brow presentation*, and complete deflexion or extension of the head, *face presentation*. The latter occurs once in some two or three hundred cases; persistence of the former, less often. The other malpresentations are *shoulder* or attempted cross-birth, and *breech*, these being self-explanatory. The latter constitute about 4 per cent. of all labors; the former a fraction of 1 per cent.

The vertex presenting, most authorities recognize four, some six, different relations to the pelvic circumference. The occiput of the fetal head being the point of direction, the sagittal suture representing the arrow, the small fontanelle, as the tip of the arrow, may be considered the index. The six positions of vertex presentation are therefore, left occipitoanterior, left occipitotransverse, left occipitoposterior, right occipitoanterior, right occipitotransverse, and right occipitoposterior. As the convex dorsal surface of the fetus best fits the ventral maternal tissues, we have the anterior positions much more frequently than the posterior. The right occipitoposterior position is, however, quite common. Whatever, in the engagement and descent of the head, may be the relation of the occiput, it is generally agreed that, in the normal mechanism of labor, the latter should have, previous to expulsion of the head, rotated to the symphysis pubis. This

rotation failing, the spontaneous termination of labor rarely occurs.

Rotation is dependent chiefly upon three factors, *vis.*: good flexion, good expulsive forces, and a good pelvic floor. This step in the mechanism normally occurs only after the latter is reached. *Primary occipitoposterior position*, especially on the right, as has been stated, quite frequently occurs, yet a large proportion of these, perhaps four-fifths of them, rotate spontaneously, after a prolonged labor, with the occiput directly anterior. Therefore, a policy of intelligent watchful expectancy is advocated in cases that seem to be progressing favorably. If the occiput remains posterior, failing to rotate, it is called *persistent occipitoposterior*. Failure is frequent in diagnosing occipitoposterior position. If in doubt, especially if the course of labor is not satisfactory, the whole gloved hand (not hesitating to use general anesthesia) should be introduced to palpate the fetal head. The location of the posterior or small fontanelle at the back of the pelvis will establish the diagnosis. Palpating the posterior ear the writer has often found the surest aid. At the same time manual aid may be given. During a pain the occiput may be drawn slightly forward or the sinciput be pushed backward. Flexion may profitably be increased by pushing the sinciput upward, or with the whole hand drawing the occiput downward. Coincidentally using approved measures for stimulating the expulsive forces, the mechanism may progress and the case terminate spontaneously as in normal labor. If after these simple expedients the occiput persists posteriorly, the preferable procedure is manual rotation done under ether, sufficient to secure thorough relaxation.

In *right occipitoposterior position*, the patient in lithotomy posture, the operator, with the left hand in the birth-canal, grasps with the whole hand the fetal occiput, gradually rotating the head from right to left. At the same time external manipulation must be done by the operator, and preferably an assistant, to rotate the trunk of the child in the same direction. The aim is to secure complete rotation of the occiput to the front. If rotation beyond the transverse is once secured, the head may be held, awaiting expulsive forces, or the forceps may properly be used to terminate the case.

It must not be forgotten that many good operators have not infrequently applied forceps and delivered with the occiput directed toward the sacrum. This is usually practicable, though often, especially in primiparæ, it is a difficult delivery, resulting in severe laceration of the perineum. Episiotomy would generally be indicated.

In *face presentation* we have a condition that often, particularly in multiparæ, ends spontaneously; hence the expectant plan is suitable under favorable progress of the case. We have the positions corresponding to those of vertex presentation. The chin is the point of direction; rotation finally brings it to the symphysis. This is imperative for delivery through the pelvis, because a *persistent mento-posterior* results almost inevitably in obstructed labor with fetal impaction and death. The cue in this presentation is to use means to accomplish anterior rotation of the chin. Secure good expulsive forces, increase manually the extension of the head, draw the chin forward, or push the forehead backward, or, with the whole hand, rotate the face and the trunk, aiding by external manipulation.

The forceps may always properly be applied with the chin occupying the anterior position; never when the chin is posterior.

Theoretically and often practically, the procedure of choice in face presentation, by means of combined internal and external manipulation, is flexion of the head, rendering the case one of vertex presentation. In mento-anterior cases the objection is that the occipito-posterior results from such maneuver. In mento-anterior cases, therefore, the obstetrician must use his judgment whether to allow the case to proceed as a face presentation, convert it into an occipito-posterior relation, which is often troublesome, or to do a version and breech extraction, cervical dilatation, pelvic size, and other essential conditions favoring the latter.

In *brow presentation* we have a variety of cephalic presentation which may be said to be transitional between the complete flexion of vertex and the complete extension of face presentation. Not infrequently it is a temporary relation, often spontaneously being converted into one of the two latter presentations. By vaginal examination the fingers may palpate the orbital ridges and the small fontanelle and, intervening, the large fontanelle and sagittal and frontal sutures. Brow presentation brings into relation to the birth-canal such large circumferences of the fetal head as to make its passage commonly impracticable. Therefore, the watchword of treatment, as soon as diagnosed, is to convert the case, by complete flexion of the head, using combined internal and external means, into a vertex presentation. Failing in the latter, version may probably be the next best procedure. Attempted delivery with forceps persisted in, in a true brow presentation,

will generally prove disastrous to mother and child.

Pelvic, commonly called *breech presentation*, the lower extremity of the fetal trunk being in advance in the birth-canal, is not necessarily an unfavorable condition. The prognosis is not quite so good as vertex presentation for the mother, especially in primiparæ, and there is a considerably higher mortality and morbidity for the child. Occasionally, external cephalic version in the later months of pregnancy can readily be done and should always be considered. If, however, as is usually the case, the condition persists, here again watchful expectancy is at first to be pursued. The membranes, if possible, as in all cases, should be preserved up to complete dilatation of the cervix, and the patient's strength conserved. Not infrequently, by keeping hands out of the birth-canal and off the fetus, the attendant will be rewarded by spontaneous delivery. Pressure from above at the height of uterine contraction, with the hands placed broadly over the fundus of the uterus, may be of material help. Often, nevertheless, there is an indication, because of threatened maternal exhaustion or asphyxiation of the fetus, actively to assist by traction from below. This probably will necessitate the procedure called **breech extraction**.

In the latter procedure, traction is first made either with fingers hooked in the groin of the fetus or by grasping an extended lower extremity—one or both extremities. In case of a narrow rigid outlet of the genital canal, time should previously have been taken for manual dilatation and stretching of the parts. As the umbilicus of the child appears at the outlet, the cord should gently be drawn down and placed in

the posterior part of the maternal pelvis, where it will be less apt to be subjected to pressure. As the fetal trunk appears, a warm sterile towel, wrung out of hot water, should be wrapped about the child to prevent premature efforts at breathing. Generally the arms will have extended alongside the head and must now be delivered. As to whether the anterior or posterior arm is first delivered, practice differs according to the operator. In any case, the trunk of the child should be turned as far as practicable in the direction opposite to the arm chosen, either forward or backward. In this way the scapula and shoulder of the arm selected will be made to appear at the outlet. The operator passes the fingers over the dorsal surface of the shoulder along the upper arm anteriorly, until, if possible, the bend at the elbow is reached. The extremity, with little danger of fracture, may then be swept downward and inward over the anterior fetal chest-wall and be delivered. The other extremity is delivered in like manner.

To deliver the head, the following maneuver usually succeeds best: The child has been brought to such a relation that its occiput lies directly back of the symphysis. The forearm of the operator supports the trunk of the fetus, which lies astride his arm. A finger of this hand is passed into the mouth of the child, with which gentle traction is made upon the lower jaw to help maintain flexion of the head. With the fingers of the other hand traction is made upon the shoulders. Simultaneously an assistant should make broad suprapubic pressure upon the fetal head. At the moment of delivery of the head, the body of the child should be raised well up over the mother's abdomen. The chin, mouth,

nose, sinciput and occiput sweep successively over the perineum. As the mouth appears, the mucus being well cleared out, delay may be well made at this point for further dilatation, perhaps thus avoiding serious perineal laceration.

In *shoulder presentation* we have a condition always imperatively demanding artificial help. For birth by the natural route, some method of version must render it either a head or breech presentation. The condition most often occurs in multiparæ as a result of relaxation of the soft tissues. If it occurs in a primipara, be suspicious of fetal and pelvic disproportion and investigate the case most carefully. If the latter is excluded, external version may properly be done and frequently with the greatest ease. This should be done in the latter weeks of pregnancy. In version, cephalic presentation should be sought. If not accomplished, breech presentation should be accomplished if possible. If, after version, the presenting part can be made to engage, recurrence of the malpresentation will likely be avoided. The patient should be examined every few days, previous to parturition, making the correction over and over, if need be. An abdominal binder may help to maintain the corrected relation. If there has been a failure to correct the condition previous to parturition, some form of version should be employed as early in labor as conditions allow. External version, a very simple and safe procedure, may now succeed; if not, the combined method; or, the membranes having been kept intact, the cervix dilated, internal podalic version followed by breech extraction is often the best treatment.

The author has done, during preg-

nancy, in a considerable number of these cases, external cephalic version with the greatest ease and simplicity, and has usually been able to bring them to an active normal parturition, with vertex presentation.

Such cases, when neglected, are melancholy and fatal to the fetus and often to the mother.

TREATMENT.—Prophylactic Measures.—We must presuppose that the **pregnant woman** has been very **carefully examined** from a physical standpoint and every constitutional abnormality noted, and that any disease of an organic nature discovered has been so treated as to avoid complicating factors. It is assumed that every means has been utilized to place the patient in the best possible condition to help her safely to pass through the trying times of pregnancy and labor. To fail in **methodically examining** the **urine** and in obtaining a careful estimate of the **excretion of urea** in twenty-four hours might prove a fatal dereliction. The urinalysis should be repeated every two weeks or oftener if any pathologic condition is shown in the examination. The presence of albumin is a danger signal; on the other hand, patients sometimes die of eclampsia without the faintest trace of albumin in the urine. It is the toxins of uncertain nature that kill, not the albumin. *It is when the amount of urea diminishes that the obstetrician should look out for storm, even if no albumin be present.*

Another important index is the **blood-pressure**, which should be **taken routinely** as the patient visits the physician's office at stated frequent intervals. A systolic pressure of 130 to 135 mm. is suggestive of a mild toxemia and should put the physician

upon his guard, while a systolic pressure of 150 mm. should lead him to employ active measures to combat a more or less severe toxemia. This sign, especially if in conjunction with a low daily output of urinary solids and the presence of albumin, should be considered ominous of an impending storm.

Other signs of toxemia should be kept in mind, such as nervous irritability, insomnia, headache (frontal), ringing in the ears, flashes of light or dark specks before the eyes, epigastric pain, disturbances of digestion, swelling of the feet or puffiness of the face. These signs, all or a few of them, should lead the alert obstetrician to an appreciation of a toxemia of a *preëclamptic* degree and should impel him, without delay, to put the patient to bed upon a milk and water diet, and very actively to stimulate all the emunctories. Failing to relieve the condition, the artificial termination of pregnancy is to be seriously considered.

It sometimes happens that a woman will go from one pregnancy to another, always losing the child either artificially by instrumentation or from the results of a prolonged labor, in whom, while the pelvis is normal, the children are all very large. This constitutes a pelvis which is relatively contracted.

Curative Treatment.—Given a case of dystocia due to *primary inertia*, what is the course to be pursued? So long as the membranes remain intact and the general condition of the mother and child remains good, patience will probably be rewarded by a final favorable progress. The heart action of both mother and child serve as a guide. If the mother is fed

well, secures sufficient rest, and the bodily functions are performed properly, no active treatment is usually indicated. If the pains are nagging to wear the patient out, **bromide or chloral**, one or a combination, or other hypnotic is indicated to secure sleep. Sometimes $\frac{1}{4}$ grain (0.016 Gm.) of **morphine**, hypodermically, is more efficient in securing rest and sleep. Should the membranes unfortunately rupture early, how should the treatment differ? Not materially, except that increased diligence should be used in cleansing the external genitalia and in protecting, by sterile napkins frequently renewed, the birth canal from infection. Even in dry labor, we may expect, as a rule, that the natural forces will, in due time, assert themselves and accomplish the desired end—even against odds. Usually within twenty-four hours, following rupture of the membranes, labor actively sets up. If, on the other hand, delay is indefinite, great vigilance against infection is imperative. If an elevation of temperature occur, some active intervention is indicated.

In a case of *secondary inertia*, labor having begun and progressed satisfactorily for a time, but pains having become inefficient or ceased, labor at a standstill, with the cervix partially dilated, what is the course to pursue? If a horse is pulling a heavy load up a long acclivity and is far from the top, but becoming weak and exhausted, it will be folly to lay on the whip. Wiser to allow the animal to rest for a brief period, to regain strength and energy. So with the exhausted uterus. And again, if rest may not be secured without sedatives a **hypnotic** or **morphine** is indicated. After a few hours rest and sleep by the patient,

the reinvigorated uterus will usually resume and promptly complete its work. When the suffering is excessive, exhausting the patient and inhibiting the contractions, the author has found $\frac{1}{4}$ grain (0.016 Gm.) of **morphine** especially effective in its results, relieving the agony and accelerating labor. **Scopolamine**, $\frac{1}{100}$ gr. (0.00065 Gm.), added may be an advantage. Should a general anesthetic for the relief of such a condition be given in the first stage of labor? Usually, no. If so, the patient will plead for more and more anesthetic, requiring for the whole process of labor an excessive quantity. The enthusiasts for **nitrous oxide** anesthesia speak most favorably of its effects, some claiming even increased activity of the uterus during its administration.

If, on the other hand, the tired horse has dragged the load very near to the top of the incline, a sharp stroke of the whip will stimulate him to supreme effort, and in kindness help him quickly to complete his task. So, if exhaustion be threatened near the termination of the first stage, some stimulation may be the best treatment. Is there any safe oxytocic? Ergot is dangerous, and absolutely prohibited. One of the preparations from the **pituitary gland** may help and may possibly be used with safety, provided it is used in minute doses. The author hesitates to suggest a remedy attended with grave dangers unless used cautiously and with nice discrimination.

An analysis of 5245 labors in which **pituitary** was used showed that there are many objections to its use, and that it is not as safe an agent as formerly supposed. There have been numerous ruptures of the uterus directly traceable to the use of this

drug. There have been numerous fetal deaths, and cases of fetal asphyxia are common. The author warns against its indiscriminate use, particularly for its effects on the child. Mundell (Jour. Amer. Med. Assoc., June 2, 1917).

[See also, for the use of pituitary, the section on PITUITARY in the first volume.]

Some have great faith in the value of **alcohol**; for instance, a glass of **sherry wine** or **port**. **Strychnine** is perhaps of some value, these latter acting as general stimulants. Strychnine may be given $\frac{1}{30}$ to $\frac{1}{20}$ grain (0.003 to 0.002 Gm.), preferably hypodermically, repeated at one- or two- or three-hour intervals. The author believes, with some authorities, that in case of weak and flabby musculature, the administration of strychnine three or four times daily in the later weeks of pregnancy will prove of prophylactic value against inertia. Small quantities of **tea**, **coffee** and **saccharose** may help in labor. **Heat** may stimulate a sluggish uterus and may be administered in the form of a hot shower or douche bath, avoiding the tub-bath.

The measures suggested are those used outside the birth-canal. What of measures within? The obstetrician should have as his motto "*Noli me tangere*," liberally and crudely translated: "Keep hands and appliances out of the birth-canal." The temptation, always great, to make repeated examinations and manipulations within has been much abused. Let us get away from the habit and avoid resulting traumatism and too frequent infection. The author advocates and practices the attendance of many cases without vaginal or rectal examinations, depending largely in

all cases upon abdominal palpation and auscultation. On the other hand, in most cases and especially in doubtful ones, at least one thorough examination with gloved hands should be made in the birth-canal. This may exclude or correct mechanical obstruction and confirm or accomplish a favorable presentation and position. An anesthetic is indicated in some cases, that the diagnosis may be sure. Routine stretching of the cervix, for example by manual dilatation, is to be condemned. However, in cases unduly delayed, **gentle, gradual manual dilatation** may, after obliteration of the cervical canal, be properly practiced to a limited degree. The manipulation will perhaps stimulate contractions. A **hot vaginal douche** may be helpful.

Other resources having failed, intrauterine irritation may become necessary. This may be by **gauze**, packed firmly into the cervical canal and vagina. The best of these devices, however, is a **conical hydrostatic bag**, introduced through the partially dilated cervix. This stimulates pains and dilates the cervix. Traction may be made upon the bag during uterine contractions. Occasionally, when the pains are infrequent and inefficient, the intra-uterine introduction of a **bougie** may be indicated. [See Induction of Labor.]

In certain serious emergencies the **cervix**, of course, may be **incised** or **vaginal hysterotomy** performed as a surgical termination of the first stage of labor. Most or all of these intra-vaginal and intra-uterine manipulations should have the facilities afforded only by a hospital.

The patient should sit or stand or walk a portion of the time and be en-

couraged to relax between pains. The physician, supplemented by a sensible, cheerful nurse, should give moral support to the patient, aiding her to assume and maintain a hopeful and confident state of mind, confident that all will end well. Proper **liquid nourishment** should sustain her strength. The lower bowel and the bladder should be kept empty. Proper rest, by artificial means if necessary, should be secured. If at any time it becomes necessary to interfere, good conservative judgment should lead one to select those measures adapted to the needs of the individual case.

Pelvimetry, carefully made, should be a routine procedure in all primiparæ and in all cases with a history of difficult labor. If external measurements indicate any narrowing, or if the measurements show a relative disproportion, internal pelvimetry should be done. This includes palpation of the pubic arch and of the pelvic cavity, but especially taking the diagonal conjugate, from which the true conjugate can be approximately estimated. If the true conjugate denotes only a relative contraction, not less than 7.5 cm., a successful labor by the natural route may be anticipated; otherwise Cesarean section is usually imperative.

If within the latter two months of pregnancy the head engages, the obstetrician can feel that "all's well." If this does not occur, estimation of the size of the fetal head should be made. Some rely upon cephalometry, but it is a refinement that others have not attained. The author would urge at least attempted fitting of the head into the pelvis by suprapubic manipulation and by the vagino-abdominal method.

If by the end of the thirty-fifth week engagement of the head cannot be accomplished, the attendant has one of two courses—either prompt **induction of labor**, or to allow the patient to go to term with **Cesarean section**, provided the test of labor fails.

Some claim favorable results in preventing over-size development of the fetus by eliminating starches and sugars and reducing liquids to a minimum of one pint a day (**Prochow-nick's diet**) in the last six or eight weeks of pregnancy. Perhaps the induction of labor at the thirty-second to the thirty-fourth week of pregnancy would be the elective treatment; or, giving the test of labor at full term, which, failing, would indicate Cesarean section.

The **postural treatment** has been little recognized, and consequently few obstetricians use it in their methods of treatment. In practice various positions offer valuable assistance.

The **lateral postures**, right and left, may be of service in posterior positions of the anatomical head, or in anterior positions in which, by turning the patient on the side, the pains are intensified. Their *rationale* is not clear, but the supposition is that they overcome the extreme uterine obliquity present in these cases, causing the fetal spine to be straightened and consequently to become more rigid. This makes it possible to carry the force of the contraction directly along practically a straight line, in this way influencing and increasing flexion or extension of the head, according to whether the vertex or face presents. The patient is turned on that side corresponding to the position of the presenting part, in R. O. P. vertex cases, on the right side, or, again, face L. M. A. on the left side.

In these malpositions, rotation may thus be promoted.

The **lateral prone postures**, right or left, may aid in a manner similar to the simple lateral postures. Modified by raising the hips by means of folded sheets, this posture may help in replacing a prolapsed cord, or in delaying a threatened precipitate labor.

The **knee-chest position** has been recommended by many as a manipulative position for purposes of operation. It is claimed that versions can be more readily done and that a prolapsed cord will of its own weight fall back into the uterus. In prolapsus funi a deliberate **version** is far preferable to measures such as this or others, at best uncertain and not reliable.

The **exaggerated lithotomy** and the **Walcher positions** are hyperflexions of the lower trunk and legs in the first named, and exaggerated extension of the same in the last named. The lithotomy position is the usual position for delivery in this country. By assuming this decubitus, the pelvic outlet is materially enlarged in all its diameters, at the expense of the pelvic inlet. Its *rationale* is the reverse of the Walcher, which will be more fully explained below. Indications for this position would hold only in contractions at the outlet or for the purpose of increasing the diameters of the outlet in normal cases. This would obtain in cases in which the head remains fixed for many hours at the outlet, owing to an apparent or real minor contraction of that part, possibly as a result of a pseudomasculine type of pelvis.

In the Walcher position we have a really valuable source of assistance. By hyperextension of the trunk, the buttocks overhanging the table and

the feet swinging free over the floor, the patient being held in place by roller sheets passing under the armpits, there occurs an increase in the size of the diameter of the pelvic inlet of from $\frac{1}{4}$ to $\frac{1}{2}$ inch, at the expense of the pelvic outlet. This increase in the conjugata vera is primarily due to a rotation of the iliosacral joints.

This position is indicated in minor pelvic contractions when the head fails to engage. The patient may be placed in this position and left there for some time till the head engages. In versions for minor contractions as the head passes the pelvic inlet it is of great service. But it must be remembered that the enlargement is always at the expense of the outlet, and, as the presenting part passes the obstruction, the patient must be thrown into the exaggerated lithotomy position to enlarge the pelvic outlet.

The **Trendelenburg posture** is of great value as a position for the total extirpation of the pregnant uterus or in acute collapse after labor. The patient lies upon her back on a plane inclined 45° or less, the lower part of the trunk the higher, the legs being flexed over the foot of the inclined plane. It has been advocated for versions and may be of help in replacing a prolapsed cord. An ironing-board or a reversed chair will answer every purpose for this position, the patient being fastened by rolled sheets.

SURGICAL TREATMENT.
—**Deep incisions into the os uteri** after the disappearance of the cervix are sometimes indicated in cases demanding rapid delivery. Two to four incisions are made, reaching to the cervicovaginal junction. The field for this operation is extremely small, and

limited to those cases in which instant delivery is indicated: rapidly deepening coma from eclampsia, embolus of the lung, severe accidental hemorrhage, impossibility to dilate by other means a spastic or cicatricial os. The presence of the cervix is a contraindication to its performance, since, with this, we get a persistence of the internal ring. Its effacement can be effected by dilating the cervix by the rubber bags or the finger until the cervix has merged into the lower uterine zone.

DEEP VULVOVAGINAL INCISIONS, on one or both sides, are a means of enlarging the vaginal outlet when, from immaturity or rigidity on the part of the patient, spasm or old cicatrices make delivery highly dangerous to the integrity of the parts, or impossible. Starting at a point superior to the posterior fourchette a deep cut is made obliquely downward and outward from the vagina, which effects an incision through, not alone the sphincter ani, but also the anterior fibers of the levator-ani muscles. (See Episiotomy.)

This produces a diamond-shaped wound, which can be readily stitched up after the delivery. Its advantages over a simple **perineal incision** are evident, when we remember that such a very superficial incision has always a tendency to tear farther and so produce irregular lacerations, difficult to sew up, instead of clean, surgical incisions which come together by suture with great nicety.

FORCEPS.—This most important and useful instrument in the entire domain of obstetrical surgery is both conservative and preservative: Conservative in the sense that it saves both mother and child the results of physical in-

jury; preservative by actually anticipating the possibility of immediate or ultimate death of the mother or her unborn child. Still, the **forceps** should never be used unless there are positive indications for its employment. The head must be in a normal position, or so relatively normal that operative interference will readily convert it into one. It is always better, however, to convert faulty positions by manual methods before having recourse to instrumental interference. In a face case, chin behind, for instance, manual flexion of the head should be resorted to, to convert it into an occipitoanterior, forceps delivery being then accomplished. The forceps is applicable only when the membranes are ruptured, which may be done immediately preceding forceps application, and when the cervix is nearly fully dilated or dilatable under anesthesia. The head must be engaged or at least fixed at the brim. Engagement of the head—a condition in which the largest circumference of the presenting portion has passed the pelvic brim—generally indicates that there is no undue disproportion and that the head can successfully pass through the pelvis.

We do not sanction the application of forceps to the head above the brim except for one indication, namely: when rupture of the uterus exists or is impending. In all other cases of floating head, we decidedly prefer the elective **version**. We fear causing a rupture, in threatened cases, or increasing the tear in already present ruptures, by doing version. Again, we do not advocate the true high forceps application, because non-engagement of the head means either a malposition or malpresentation, or

a pelvis that is relatively or absolutely contracted.

In pelvic contractions, especially of a minor type, the mechanism of labor is different from that which takes place in normal ones. The head often engages transversely instead of obliquely. Since many pelvic contractions are anteroposterior, with compensating increase in the transverse diameter, it would appear that nature conforms with what would be an ideal attempt on her part to overcome the dystocia. If the forceps is applied as usual along the sides of the pelvis, pressure is exerted from side to side. According to observation, the pressure from side to side causes an increase in the biparietal diameter, which conforms to the contracted anteroposterior diameter, and in this fashion increases the pelvic contraction both relatively and absolutely. For this reason version is elected, for, under the above conditions, the after-coming head, descending, as it should transversely, pressure is exercised by the anteroposterior contraction on the parietal bosses. This diminishes their diameter where the greatest contraction exists and affords compensatory side-to-side enlargement, which conforms to the enlarged transverse diameter. This, we believe, explains the superiority and safety for both mother and child of version over the high forceps application.

The writer believes it to be very unfair and unjust, non-professional, for a physician to apply the **forceps** simply because he is too busy and cannot wait for the natural forces to act. A. Isaacson (N. Y. Med. Jour., July 9, 1910).

To repeat and emphasize, the prerequisites of justifiable forceps application are vertex or face presentation,

complete dilatation of the cervix, engagement, ruptured membranes, and a living child.

Forceps should never be applied, in face presentation, with the chin posterior to the transverse diameter; and seldom in vertex presentation when the occiput is posterior. The former must be first manually rotated anteriorly; the second should be so manipulated. In failure to rotate the occiput, the author and others sometimes deliver by forceps, occiput posterior, face to pubes. Perhaps the most common cause of failure of a successful outcome is attempted delivery through a partially dilated cervix. The life is often "dragged out" of the fetus and the mother seriously or dangerously injured. Infinitely better is a little more patience in awaiting complete dilatation or assisting in its accomplishment.

Another common mistake is that of making undue traction, the forceps once properly applied. Perhaps the attendant has made a mistake in judgment, that the head was only fixed and not engaged. Maybe he was mistaken and the presentation or position is not correct. The force of traction is best gauged by the operator using the strength that may be exercised by the forearms as he stands squarely upon both feet.

It sometimes seems to be an excited obsession of an operator, once the forceps is applied, to "get the child out" at all hazards or at any cost, by making violent traction such as common sense—much more obstetric sense—should tell him would crush the life out of the child and inflict desperate traumatism upon the mother. Infinitely better to have done craniotomy upon the living child and to have saved the mother. However, craniotomy

upon a living child seldom seems necessary and is perhaps never justifiable. Other methods are always available.

If after a fair, careful traction, the head does not advance, the only proper procedure is to remove the instrument and re-examine. **Podalic version** and **breech extraction** will often happily relieve a trying situation. Frequently, **manual correction** may readily put the presenting part in a favorable relation for a reapplication of the forceps and a prompt delivery. The author wishes to emphasize the value of palpation of an ear of the fetus in diagnosing malpositions. If the child is dead, **craniotomy** should precede delivery.

The forceps blades should be applied to the sides of the fetal head, or approximately so, in the biparietal diameter. Here, again, palpation of an ear will aid. However, all good operators have made perfectly successful deliveries with one blade in the temporal area and the other in the posterior parietal region. As delivery progresses, rotation may aid the operator in adjusting the blades to the parietal areas.

Traction is the sole function for which forceps should be used. Experts claim the ability to use the instrument safely as a rotator. If so, the average operator dare not rashly face such danger; and could not the expert quite as successfully, and much more safely, have accomplished the end sought, by the hand?

Traction should imitate nature, in her expulsive efforts, by intermittence—traction and rest. Uterine and voluntary force should, if possible, be the chief factors in delivery of the child, the forceps merely artificially aiding at the height of pain. The pull should, of course, be in the direction of the axis of the birth-canal. If the head is

high, the mother on her back, traction should be downwards and backwards.

This naturally raises the question as to the type of forceps most desirable. The author has long held that any case suitable for forceps can be delivered with the simpler **Simpson type**. It depends chiefly upon the man and not upon the instrument. A good instrument requires, of course, that the blades be so shaped as to fit the fetal head, to grasp it firmly and securely without undue pressure either upon the fetal head or maternal tissues. The simple instrument, if made of good length, readily lends itself to axis traction. After satisfying himself that the instrument is properly applied, the operator with one hand grasps the handle and makes traction in the direction of the latter. At the same time, with the other hand in the region of the lock, pressure is made directly downward, the latter hand serving as a fulcrum. The resulting force is downward and backward, an axis traction, so to speak,—a traction in the direction of the axis of the birth-canal.

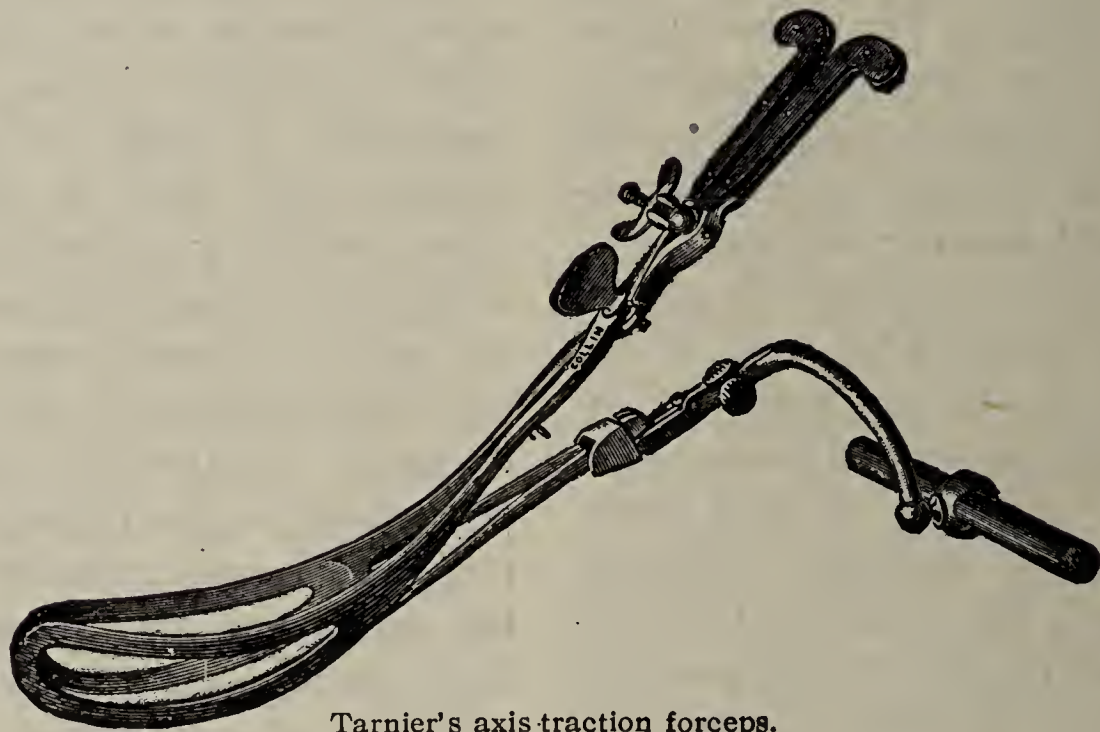
Good operators differ in practice at the moment of delivery of the head. Some remove the forceps immediately before delivery. Others equally good deliver the head with the instrument, one hand managing the instrument, the other protecting the perineum. In either case the latter should be done.

The use of **high forceps** in the **delivery** of the child is not a surgical procedure, for by this operation an attempt is made to pull through a mass which is larger than the cavity it has to pass through. The greatest amount of injury to the maternal soft parts takes place during high forceps delivery, and even if repaired, the results are not always good. Postpartum sepsis follows more often

high forceps delivery than any other obstetrical operation, for it creates large areas of wounded surfaces which cannot be repaired. Rongy (Amer. Med., Aug., 1911).

The **high forceps operation** is always considered a major operation by the writer, one to be performed only by the trained obstetric operator. It is never to be selected before labor as the ultimate operation. J. A. Harrar (Amer. Jour. of Obstet., Feb., 1913).

and the point of junction of the traction rods with traction cross-handle, must always be nearly in contact, just barely touching, and this relation must be maintained until the patient is practically delivered. To allow the two parts to come into contact will at once influence the utility of the handle-tips as indices, for the tendency would then be to push the handles too rapidly forward and so



Tarnier's axis-traction forceps.

The indications for the use of the **axis-traction** (*Tarnier's*) instrument are in nowise different from those of the ordinary forceps. Nor does their application differ from that of the latter. It is only after they are locked and ready for use that the mechanism begins to differ. In their use the following rules must always be adhered to:—

The handles of the blades must be a guide as to the direction of traction, no matter what their position. The position of the blade in its relation to the pelvis must never be taken into consideration and certainly must never influence us as to the direction of our traction energy. The button on the traction handle,

give us a false conception of the true and ideal axis-traction; its effect would thus be spoiled and our energy rendered futile. Traction is then to be made and continued, the traction handles carried farther and farther forward and upward until the head begins to crown. It is now advisable either to remove the forceps, or, if the head is to be delivered solely by the forceps, the operator stands to one side of the patient, and grasps both traction rods and forceps handles in one hand, while with the other he manages the perineum.

Version, a turning of the child so as to substitute for the part presenting, some other fetal part, is named cephalic or podalic—the former when the head

is made to present, podalic when the buttocks are made the presenting part. According to the method employed, it is called external, internal, or combined version.

Cephalic version is rarely done except in correcting a shoulder presentation, more rarely in substituting the head for a breech presentation. The former by the external method, one hand upon the breech, the other upon the head, is often such an easy manipulation that it should always be tried in the latter weeks of pregnancy or early in labor. Conversion in a primipara of a breech into a cephalic presentation is, theoretically, very desirable, but not always, by external manipulation, practicable. If not accomplished by the external method, usually it is advisable to conduct the case as a breech throughout.

The *combined* or *Braxton-Hicks method*, manipulation with a hand externally upon the fetal parts and with two fingers within the cervical canal, is sometimes useful when external version has failed to convert a shoulder presentation into either a cephalic or breech presentation. Its chief value, perhaps, is in doing podalic version in order to staunch the blood in placenta previa. (See PLACENTA PREVIA.)

On mention of version, internal *podalic version* is at once thought of, the value and advantages at times of the other two methods often being overlooked. While a large proportion of obstetricians are not ready to follow the lead of *I. W. Potter*, of Buffalo, and deliver their cases routinely by version and breech extraction, yet the procedure is recognized as most valuable in several conditions. It is indicated sometimes when immediate action is necessary and forceps is imprac-

ticable or contraindicated, for example, in placenta previa, prolapse of the cord, or eclampsia; also in shoulder presentation—early cephalic version having failed; in delayed first stage occipito-posterior position, or face presentation, and especially in pelvis of moderate relative contraction, flat pelvis particularly, in which the head fails to engage. (See Forceps.)

The conditions essentially present to allow or justify the maneuver are complete dilatation of the cervix, the presence of amniotic fluid, no excessive fetal and pelvic disproportion, and the absence of tetanic contraction or contraction ring of the uterus.

The most conscientious and diligent care as to surgical cleanliness must be observed. With the patient in the lithotomy position, the bowel and bladder empty, the hand (gloved) of the operator is used, the palm of which most naturally faces the fetal abdomen. The hand, folded into a cone, is slowly and carefully introduced until the membranes are reached, which, if not already ruptured, are perforated with the finger; the presenting part is gently pushed aside, the hand within the amniotic sack seeking a foot. The procedure is done with the patient under complete anesthesia, with thorough relaxation. If a uterine contraction occurs, the hand should be allowed to rest limp until the contraction ceases. A foot having been seized, it is gently drawn down into the vagina, simultaneously pushing the head with the external hand towards the fundus of the uterus. It is desirable to secure that leg which will most readily come anterior when the version is completed. Having done the version, nature's efforts at expulsion may be awaited, or the condition may be such as to demand

prompt delivery by **breech extraction**. (See under Breech Presentation.)

Symphysiotomy, cutting through the pubic joint, and **pubiotomy** (**hebosteotomy**), sawing through the ramus pubis, are means of enlarging a contracted pelvis, increasing the true conjugate 1 to 1½ cm. and the other diameters of the inlet twice as much. Of the two procedures, most operators give preference to the latter as being the more favorable as far as the mother is concerned.

Operators of the largest experience have discarded these operations in primiparæ, and will not perform them in cases complicated by heart and kidney diseases, infection of the parturient canal, extreme obesity, colossal varicosities of the genitals, nor extremely large child. In general, their field will be limited to pelves having a true conjugate of not less than 7.5 cm. when the conditions for Cesarean section are not ideal.

When, in a multipara, in a case of the type under consideration—of moderate pelvic contraction—expectancy has shown that the head is too large to go through spontaneously, and a gentle trial with the forceps has proved the disproportion to be greater than was expected, **pubiotomy** is the operation of choice, provided both mother and child are in good condition. The best time for Cesarean section is gone by, but the section of the pubis offers excellent chances of saving the two patients. This is an advantage of pubiotomy—it enables us to subject the woman to the test of labor.

Cesarean section, removal of the child through abdominal and uterine incision. The indications are either positive or relative. The former exists when the birth-canal is narrowed

to such a degree that the child cannot—even by embryotomy—be delivered with safety to the mother. It is generally considered that a pelvis with an internal conjugate of 7 cm. or less, renders the case one necessitating Cesarean section.

The relative indications, stated broadly, are present when, in the judgment of the obstetrician, Cesarean section offers a better chance for mother and child than delivery from below. This class is made up largely of those cases of moderate pelvic contraction—an internal conjugate of 7 cm. or more, but considerably less than the normal of 11 cm.

By careful antepartum study, induction of labor before term, the test of labor at term (not infrequently with spontaneous delivery), forceps delivery, podalic version, possibly pubiotomy, or Cesarean section after the beginning of labor—these are all carefully weighed and passed upon by the judgment of the conscientious obstetrician.

Eclampsia, central placenta previa, abruptio placentæ, uterine rupture and cancer of the cervix are conditions occasionally indicating Cesarean section.

In cases in which it is feared infection is present, and especially in which it is clearly indicated by fever and rapid pulse, the operator should hesitate to take the risk. If undertaken, a **Porro** or a **modified Porro** should be done—**supravaginal hysterectomy**.

The classic Cesarean includes the longitudinal incision of both abdominal wall and uterus without delivery of the latter from the abdominal cavity, in evidently clean cases. In doubtful cases as to infection, the uterus should be delivered before its incision. The peritoneal cavity can better be protected from the amniotic fluid. Careful su-

ture of the wounds is of utmost importance. Bleeding, if **ergot** and **pituitary** are previously administered hypodermically, is not serious and generally needs no special control except by suture. With apparent infection, extensive fibroids or severe uterine rupture, **supravaginal hysterectomy** should be done according to the usual technique. Occasionally carcinoma of the cervix will indicate complete hysterectomy.

Realizing the high maternal mortality attending the classic operation when the case is frankly infected, the profession has sought means of overcoming this danger. Much was hoped for **extraperitoneal section**, by incision immediately above the pubis, dissecting up the peritoneum, and pushing aside the bladder in such a way as to expose the lower uterine segment, through which the child is delivered. But the operation, on the whole, has been disappointing. It is technically difficult, often attended with much traumatism, and infection of the connective tissues is prone to result.

Many operators, Beck and De Lee especially, are highly in favor of the low uterine incision, which may be called **laparo-trachelotomy**. After abdominal incision immediately above the pubis, the peritoneum covering the uterus is incised transversely directly above the bladder. The bladder is bluntly dissected downwards from the uterine wall, and the uterine peritoneum reflected upwards. The uterine muscle is thus laid bare, and through it a longitudinal incision is made. The peritoneal cavity is meanwhile carefully protected from soiling.

In completing the operation the uterine muscle is carefully sutured, the bladder restored to its proper position, and special care taken in covering the

uterine wound with the peritoneum—the upper and lower peritoneal flap overlapping somewhat. Some of the advantages claimed are, less shock because less handling of viscera, less probability of adhesions or subsequent uterine rupture, and particularly less danger of infection or, if it occurs, likely to be extraperitoneal and localized, and can be readily dealt with.

The more favorable method in cases of central placenta previa is **Cesarean section**, as the hemorrhage is much less than by any method of vaginal delivery, the placental site being undisturbed. The shock of operation is no greater, especially in primiparæ with no attempt at labor. The child is given every chance to live and the mother, if she recovers, is left in much better physical condition. Also the danger of infection in unhandled cases is certainly much less by section and free drainage. Foulkrod (*Amer. Jour. of Obstet.*, Mar., 1913).

A comprehensive study of the results of **Cesarean section** in 4 cities by the writer showed that the mortality was very high in the hands of the inexperienced or general surgeon. The most essential factor for success, in absolutely competent hands, is that the cases should be selected with the greatest care and that operation should be refused to all patients in whom uterine infection can be demonstrated or is even seriously suspected, provided delivery can be accomplished by some other means. If, however, abdominal delivery seems the only possible solution complete **hysterectomy** should follow delivery of the child and placenta. The patient on whom a vaginal operation has been attempted unsuccessfully is an extremely bad risk for a Cesarean section. Pre-eclamptic toxemia and eclampsia show a distinctly higher mortality than when delivery is effected by other means. A previous Cesarean section should generally be followed by Cesarean section in sub-

sequent labors. Newell (Jour. Amer. Med. Assoc., Feb. 24, 1917).

Vaginal Cesarean section, or colpo-hysterotomy, is a measure that may occasionally be used with advantage when the cervix is tightly closed or it is the site of some obstruction, and an indication arises for quick delivery.

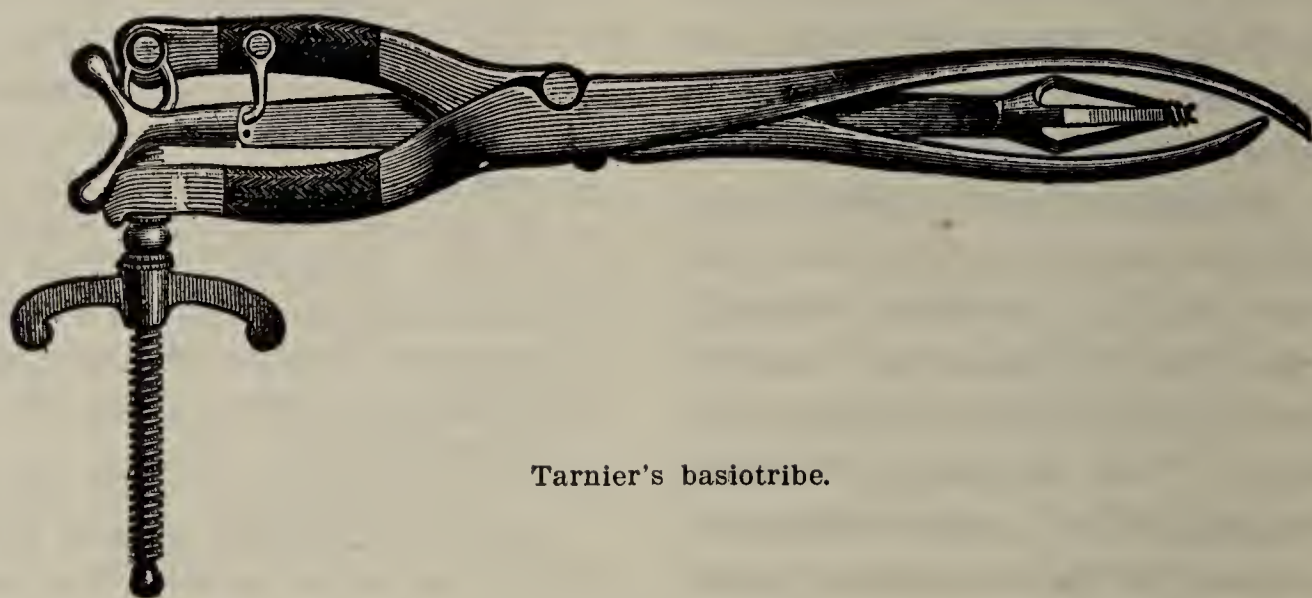
In order to reach the anterior wall of the cervix and lower uterine segment, two incisions are made through the vaginal wall, one-half encircling the cervix, another at right angles joining the first in the mid-line of the an-

terior vaginal wall. Through this free opening the base of the bladder is reached, this organ being freed by blunt dissection from the anterior uterine wall as high, if need be, as the vesico-uterine peritoneum. The latter should not be opened. Meanwhile, step by step, the cervix fixed and drawn down by volsellum forceps, the anterior uterine wall, including the cervix, is split in the mid-line with scissors. This opening may give room for the delivery of the child. If not, the posterior wall is also split, pushing the peritoneum off, if incision is necessarily so high, from the bottom of Douglas's pouch.

It may be indicated in acute heart or lung affections, eclampsia, abruptio placentæ or fetal asphyxia. Cancer of

the cervix and stenosis of the cervix from old scars may be indications. The field for this operation is quite limited. Delivery of a living child from below must be possible; therefore the pelvis must be large enough and the position and presentation of the child favorable. The operation simply overcomes the resistance of the cervix and is one not to be undertaken by one unskilled in pelvic surgery.

With a living and viable child the **abdominal operation** should be the operation of choice except in women



Tarnier's basiotribe.

with relatively large pelves and vaginae. This exception does not apply in placenta previa, in which condition **vaginal Cesarean section** is rarely if ever indicated. The vaginal operation should be elected when a quick delivery is necessary, and the only obstacle to delivery is an undilated os. In many multiparæ the vaginal operation is to be preferred. Infection does not indicate either route in preference to the other, but it adds to the mortality in either case, and teaches that the operation should not be one of last resort for either route. With a dead or dying mother, and a living, viable child, the abdominal route should be chosen. A correct knowledge of the indications for these operations and a timely resort to them will reduce both the maternal and fetal mortality and morbidity which now obtain in obstetric prac-

It may be indicated in acute heart or lung affections, eclampsia, abruptio placentæ or fetal asphyxia. Cancer of

tice. Porter (Amer. Jour. of Obstet., Jan., 1910).

Surgical Measures Indicated in Fetal Obstruction.—These are all destructive to the child; they are, however, conservative, since they are preservative to the mother. In actual practice our first duty is to the mother, and under no condition should danger to the child influence the obstetrician in increasing the danger to the mother, unless, of course, the full consent of both parents is obtained. Where mother and baby have equal chances, those chances should be well weighed and operative influence estimated. In all difficult and prolonged labor cases in which many operators have examined and many instruments have been used, and operations have been attempted and failed, the child, as a result of these prolonged, fruitless, and severe manipulations, has often suffered so severely as to have been nearly or already sacrificed. In such cases, a deliberate **perforation** ought always to hold preference. The perforator is an instrument still possessed of a large field of application. It is our rule to perforate or dismember in all cases in which the child is dead, no matter what its position in the pelvis is, except where the head can with safety to the mother be delivered by instrumental or manual extraction. We therefore have at our disposal the following operations: 1. **Basiotripsy.** 2. **Total embryotomy.** 3. **Decapitation.** 4. **Cleidotomy.** The writer, in cases indicating **craniotomy**, has frequently perforated with Smellie's scissors and then delivered with forceps.

BASIOTRIBE.—In the place of the cranioclast, the **basiotribe** of Tarnier

has proved a wonderfully successful and staunch instrument. When once it is in place, it holds on "like grim death." Its application is somewhat complicated, since its three distinct parts act in unison, the central part the perforator, on each side the heavy cephalotribe-like blades gripping, not alone the head, but the base of the skull.

TOTAL EMBRYOTOMY is rarely performed since one or the other of the destructive operations will usually answer.

DECAPITATION.—In impacted transverse or shoulder presentations a deliberate **decapitation** will nearly always precede an **embryotomy** if the latter operation is at all necessary. But when after decapitation it is impossible because of spasm to deliver, dismemberment is in order; or, if the child be macerated, it is also indicated, since a purchase on one or both feet will result in their being torn off. In locked twins it may become necessary to decapitate one or both children.

CLEIDOTOMY, or cutting through one or both clavicles, is one of the new destructive operations. It is indicated in impacted shoulders either in case of spastic contraction or when the shoulders are abnormally developed and large. Thus, occasionally, after delivering the head, it is impossible to deliver the trunk because of a pair of enormous shoulders. The child promptly dies, and brute force would only succeed in making frightful lesions of the genital tract. If now a pair of stout scissors are introduced and the clavicles are deliberately cut through, the chest instantly collapses, its diameter is diminished, and speedy delivery follows.

ARTIFICIAL ABORTION AND INDUCTION OF LABOR.—The term “abortion” is applied when the uterus is emptied of the product of conception, either spontaneously or artificially, before the fetus is viable, that is, before the ovum or fetus has reached that stage of development when it is fitted for extra-uterine life. Artificial abortion is a procedure performed purely in the interests of the mother. Premature labor, on the other hand, when induced, carries with it the assumption that the fetus is viable,—that is, that it is capable of surviving apart from the mother. The operation, then, is resorted to both in the interest of mother and child, although ordinarily those of the former chiefly urge the physician to resort to it. The induction of premature labor is, in general, an elective operation; artificial abortion is usually forced upon the physician. The factors calling for each operation are different, as are also the methods of procedure. It is useful, therefore, to consider them separately.

Except in strict emergency, induction of abortion or labor should never be done without the support of a consultant.

THERAPEUTIC ABORTION is rarely indicated. Among the conditions sometimes demanding abortion are **pernicious nausea and vomiting** with evidence of **toxemia**, **advancing tuberculosis**, **decompensating heart disease**, **nephritis especially with complicating retinitis**, **diabetes**, and other diseases that seriously threaten the mother’s life, such as **leukemia** and **Basedow’s disease**. **Bleeding** to an alarming extent may necessitate emptying the uterus, as well as diseases of the ovum, *e.g.*, **hydatiform mole**.

Methods.—Artificial abortion, in the first three months of pregnancy, can best be completed in one stage or sitting. It is imperative that it be done with the greatest surgical cleanliness, the technique as careful as if the abdomen were to be opened. This includes hands and dress of the operator, rubber gloves, all instruments and appliances sterilized by boiling, drapery for the patient, and the surgical preparation of the vulva and a large surrounding field, shaving of the parts being among the first steps in the latter.

The patient being in lithotomy position, under general anesthesia, the vaginal walls are retracted, the cervix fixed with volsellum forceps, and the cervix dilated, preferably with graduated metal bougies, if it is readily accomplished, to a degree admitting a gloved finger. With a hand on the abdomen, the uterus may be pressed down upon the internal finger with which **digital curetment** (cavage) empties, or almost completely empties, the uterus. With a flush curet (using a stream of sterile water or mildly antiseptic fluid), the uterine cavity is very cautiously but thoroughly **curetted**—cautiously, because the operator should always bear in mind the extreme ease with which the puerperal uterus is sometimes perforated. No packing need be introduced unless bleeding persists or the operator fears that portions of the secundines remain. If dilatation to admit a finger is not practicable, the uterus may be emptied solely with the curet, or, rarely, with the aid of the **ovum forceps**. The latter is also a dangerous instrument and, if employed, should be used only with great caution.

After the third month, it is usually advisable to do the operation in two stages. On the first day the cervix is

dilated, the amniotic sac punctured and the lower segment of the uterus, the cervix and the vagina packed with gauze. Usually within a few hours, pains set up and generally continue, sometimes expelling the contents of the uterus, or at least dilating the cervix sufficiently, within twenty-four hours, so that the uterus may be artificially emptied, as indicated above. Sometimes, within the second three months, especially if advancement of pregnancy approaches the period of viability, the procedures employed for the induction of premature labor (see below) are used with the best advantage. It should be remembered that, wherever possible, in emptying the uterus, the fingers are to be used in preference to the curet or the ovum forceps.

The after-treatment should include careful external surgical cleanliness (no internal douches), **ergot** and **strychnine** four times a day, and rest in bed for at least one week, with the head of the bed elevated.

THE INDUCTION OF LABOR.

—By this is meant the interruption of pregnancy after the period of viability; if before full term, it is called premature labor.

Among the most common conditions justifying the procedure are a **contracted pelvis** or an **over-sized child**, and **disease seriously threatening** the life or future health of the **mother** or the life of the **fetus**. Most of the conditions mentioned under THERAPEUTIC ABORTION may be included, and in addition are **threatened eclampsia**, **placenta previa**, **abruptio placentæ** and various **psychoses**. The habitual death of the child before term, or pregnancy prolonged beyond term, may be an indication. When done for the sake of the child, there

must be assurance that the child is alive and has reached the period of viability.

The chances of a long survival of a child delivered before the thirtieth week are very small.

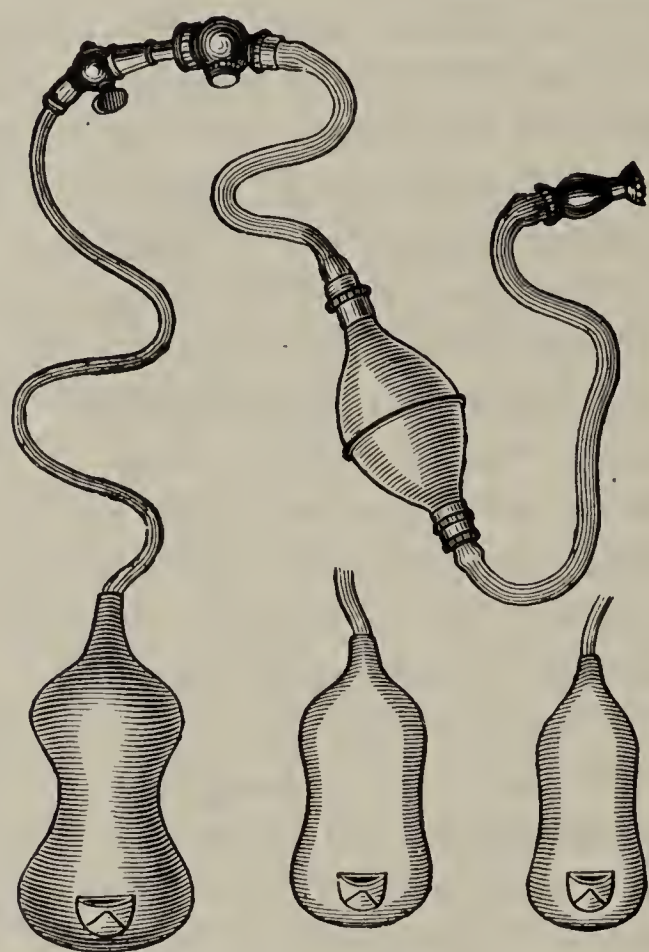
It must also be predetermined that the pelvis is sufficiently large to allow the viable child to pass through,—the internal conjugate not less than 7 or $7\frac{1}{2}$ cm.

Methods.—While drugs are entirely unreliable, many believe that giving small doses of **strychnine sulphate** for a few weeks previously, $\frac{1}{40}$ gr. (0.0016 Gm.) *q.i.d.*, gives tone to the uterine muscle, and if induction of labor is contemplated, the dosage may be increased at that time. A large dose of **castor oil** is occasionally followed by labor. Some testify to the efficiency of one or two large doses of **quinine**, preferably in solution, 10 to 15 grains (0.6 to 1 Gm.), the latter sometimes to supplement the oil.

The approved methods include the intrauterine use of **bougies**, of the **hydrostatic bag** and of **packing**. The simpler and perhaps the safer method from the standpoint of infection is that of packing the lower uterine segment lightly and the cervical canal firmly with a strip of gauze three inches wide and several yards long. (See surgical cleanliness under THERAPEUTIC ABORTION.) This may be readily done, usually without anesthesia, in the lithotomy position, and vaginal retraction effected, exposing the cervix. The latter, steadied by tenaculum forceps, can usually be dilated with a finger, or if not, with large solid metal dilators. Gauze may then readily be introduced with uterine dressing forceps or through a packing tube, care being exercised not to rup-

ture the membranes. The author usually packs the vagina also.

Many depend largely upon the introduction of bougies. The danger of infection is slightly more than other methods, but can be averted by scrupulous aseptic technique. The membranes are sometimes accidentally punctured and rarely severe placental hemorrhage has been set up. Anesthesia is not generally necessary.



Barnes's bags.

The cervix is slightly dilated as outlined above. Preferably, two, in succession, soft rubber sterile bougies, large catheters or small rectal tubes, are passed into the uterus behind, in the direction of the fundus. They, of course, should be inserted between the amniotic sac and the uterine wall. If the former should be adherent at the internal os, it should be gently separated by the finger. The effect of the tubes may be aided by packing a narrow strip of gauze into the lower uterine segment and the cervix.

The upper vagina should also be tamponed.

There are advantages, at times, in the use of a hydrostatic bag in the lower uterine cavity. This device may be as efficient as any other in stimulating uterine contractions, and its direct dilating effect on the cervix is often an advantage. The latter is especially true when the membranes have ruptured, or when there is uterine inertia. Several types are available, but the simple conical (Voorhees) bag with a flat top seems best. It comes in a series of different sizes, made of soft rubber, fortified with fabric, a tube extending from the narrow end, which, when the bag is in position, protrudes from the vagina and through which the bag is filled.

For introducing the bag, the cervix is exposed and fixed, and if not already sufficiently open, is slightly dilated—enough to admit a finger or a good sized bougie. The bag, empty and folded longitudinally, is grasped with uterine dressing forceps and readily introduced through the cervix. Sterile water or one-half per cent. solution of liq. cresol. co. is then forced into the bag by a piston or Davidson syringe. The bag should, previous to its introduction, have been tested as to its capacity and strength. When in place, it should be distended until it is only moderately tense. The examining finger will help determine this, and slight traction on the tube will assure the operator that there is proper adjustment. The tube is clamped with a hemostatic forceps and may be held up by fastening it to an abdominal binder.

It would seem superfluous to emphasize the imperative necessity, in all these manipulations in the par-

turient canal, for the most scrupulous and conscientious care in the observance of surgical cleanliness. The bag is sterilized by boiling and the cervix should be so exposed by specula or retractors that the former may be introduced without coming in contact with vulva or vagina.

The care of the patient during induced labor does not differ materially from that necessary in spontaneous labor. The external genitalia should be well protected with sterile napkins and frequently flushed with a mild antiseptic.

The size of the bag chosen will depend upon the condition. If it is chiefly to stimulate the uterus to the onset of labor, one of the smaller ones should be chosen. A large one is more liable to displace the presenting part. When the smaller one passes from the cervix, labor may be progressing satisfactorily, and, unless there is some emergency, we may better await spontaneous progress. If, however, the contractions are weak and inefficient, or there is need of hastening dilatation, a second larger bag may be introduced, sometimes one sufficiently large to dilate the cervix completely. Moderate traction upon the tube in conjunction with uterine contraction will speed the dilatation. Care should be used not to do the latter to excess, for fear of cervical laceration.

MANUAL DILATATION.—A means, much abused, of accelerating the first stage of labor, but which may be justified and most helpful at times, is **manual dilatation**. Infection and severe injury, even to the extent of complete uterine rupture, have resulted. It may not be properly employed until the effacement of the in-

ternal os and cervical canal has been accomplished. Its use previously is attended by grave danger of extensive tear with severe hemorrhage. A common mistake is made of too great haste. Nature should be imitated by dilatation and relaxation. Anesthesia is usually indicated. When labor is delayed by fear, excitement, or pain, short complete anesthesia with moderate manual dilatation may have a wholesome effect in the subsequent spontaneous progress. If the cervix is directed too far back, it may at the same time be drawn forward. When the cervix is two-thirds or three-fourths dilated, the other conditions for forceps or podalic version being fulfilled, manual means may often readily and happily complete the dilatation.

There are two general methods, *unimanual* and *bimanual*. The former (*Harris's*) consists simply of introducing one, two, and finally all the fingers of one hand, followed by the thumb, through the os. The hand within the os is expanded so that when the closed fist can finally be drawn out the process is supposed to be complete. The *bimanual* is preferred by the author as being more rational in imitating nature; there is less danger of injury to the parts, and less likelihood of rupturing the membranes or of displacing the presenting part. It can be done outside a fetal part occupying the cervix. The forefinger of one hand is introduced within the cervix, then the corresponding finger of the other hand, the fingers back to back. Soon two fingers of each hand are introduced, with which pressure is made outward and downward in opposite direction, the knuckles serving as a double fulcrum. The points of pressure upon the cervical ring are changed

frequently, encircling the whole circumference with the dilating force. The free fingers should be protected from contact with the perineum and anus by a sterile towel.

VAGINOPERINEAL INJURIES. SURGERY OF THE PERINEUM.

—Laceration of the perineum may be described as a splitting of the perineal body, which latter directly or indirectly supports the bladder, rectum, uterus and the intestines. Various degrees of laceration are described which may be classed under the heads: "Complete" and "Partial Tears." These include the following degrees:

Superficial laceration of the fourchette and perineum, not involving the sphincter.

Laceration to the sphincter ani.

Laceration through the sphincter ani.

Laceration through the sphincter ani and involving the rectovaginal septum.

The former two are called incomplete; the latter two complete lacerations.

Not infrequently subcutaneous rupture of the muscular tissue and fasciæ of the perineum takes place, leaving the skin and mucous membrane intact. Cases of laceration of this type are called concealed lacerations and are followed, as in the other forms, by relaxation of the pelvic floor and loss of perineal support.

SYMPTOMS.—The symptoms resulting from perineal laceration are, a feeling of weakness and dragging down of the pelvic viscera, later the prolapse of the various organs resulting; prolapse of the vagina with cystocele or rectocele, one or both; and prolapse of the uterus. When the rupture is complete, to these may be added incontinence of feces and intestinal gases and prolapse of the rectum. As an excep-

tion, the patient may suffer but little even when the two passages are laid into one; but generally the patient's condition is a sad one. Fecal matter and gases pass without control, and the pelvic organs tend so strongly to descend that exercise or muscular efforts, produce a sense of weariness, pain throughout the pelvis, and traction upon the broad ligaments.

DIAGNOSIS.—The diagnosis of this condition is made by inspection.

ETIOLOGY.—The most common causes of laceration of the perineum are rapid delivery, unusually large head, a narrow rigid vulvo-vaginal outlet, a persistent occipitoposterior position, or the after-coming head in breech extraction.

PATHOLOGY.—In partial perineal ruptures there is the exposure of a more or less extensive raw surface, richly supplied with blood- and lymph-vessels. This raw surface is, as a rule, indisposed to heal by first intention and over its surface for two or three weeks there is an uninterrupted flow of lochia, consisting of disintegrated muscular tissue, decaying and flaking decidua, disorganized blood, and mucopus. In complete perineal rupture, the presence of fecal matter and intestinal gases are added. Rupture of the perineum may lead to septicemia, anterior or posterior displacement or prolapse of the uterus, cystocele, rectocele, uterine engorgement and hyperplasia, subinvolution of uterus and vagina, and more or less invalidism.

TREATMENT.—All obstetricians agree that perineal lacerations should be closed by **suture**. By far the most practice and advocate *immediate suture* for the purpose of securing primary union, if possible. Thus, hemorrhage is arrested, the probability of entrance of infection is lessened, involution be-

gins promptly, the convalescence of the patient is shortened, and she is saved the annoyance and, perhaps, the expense of a future anesthetization and operation. This school of obstetricians would delay repair in cases of extreme exhaustion, extensive bruising and swelling of the genitalia, especially with infection already present.

A smaller number of obstetricians (*e.g.*, B. C. Hirst) favor *intermediate repair*, approximately one week following labor. Advantages claimed for the latter are that the extent and character of the wounds are more readily determined in a field now free from blood and swelling that exists at the termination of labor, that better coaptation of the wound surfaces and restoration of the structures to their normal relations are secured, and that fewer failures are experienced. At this time, the cervix will show whether it needs suture, and if so, can readily and safely be done. Most all oppose immediate repair of the cervix, especially because of the danger of introducing infection. In intermediate repair, preliminary to suture, the wound surfaces must be freshened by rubbing them with gauze or scraping with knife or scissors. Sometimes small portions of tissue will need to be excised. As a preliminary to repair, a good light is essential; small lacerations may sometimes be primarily repaired without, but usually **general anesthesia** will shorten the procedure and insure better closure of the wound. A sufficient **vaginal packing** of sterile gauze should be used to keep the field free of blood from above.

The most frequent causes defeating success (hence to be avoided) are a lack of closure of the upper angle of the wound; failure in passing the sutures to go below its depth, thus leaving a

dead space; or failure to pass the needle deeply into the tissues retracted from the median line. A mistake easily made is that of drawing the sutures too tight.

No one has a right to practise obstetrics who does not fit himself to make necessary repairs. Such ability requires only the appliances, a fair knowledge of the anatomy of the parts, and the application of the ordinary principles of surgery.

One fact should be kept clearly in mind—that perineal injuries generally involve two surfaces, vaginal wall and skin perineum, and sometimes a third, the rectal wall.

In repair of an *incomplete laceration*, the wound is first closed upon the vaginal surface, beginning at the upper angle of the tear, passing with curved needle around at right angles to the tear and beneath its depth. The interrupted sutures are passed one after another from above downward, one-fourth inch apart, until the commissure is reached. Each stitch enters upon the vaginal mucous membrane one-half inch or less from the torn surface and issues at a corresponding point on the opposite side. The sutures are tied and cut short.

When the wound is deep, perhaps involving the levator muscle, it is often advisable to close the depth of the wound with a line of sutures which will later be buried by a second series closing the overlying structures.

The wound on the vaginal surface often extends not in the median line, but in one sulcus; or not infrequently, the two sulci are involved, extensions of the tear in the midline of the skin surface. If so, two lines of suture must be used from the vaginal surface. The operation is completed by closing the wound from the skin surface, su-

turing from below upward, meeting the vaginal line of sutures at the commissure. Again, be sure that the skin sutures encompass the depth of the wound remaining. Twenty-day catgut, No. 1 or No. 2, serves the purpose of repair well. Some prefer one or two or all silkworm gut sutures for repair from the skin surface.

In repair of a *complete laceration*, particular attention must be directed to the sphincter ani, frequently to the torn and retracted fibers of the levator ani, and occasionally to the involved rectal wall.

Good assistance will be necessary. A torn end of the retracted sphincter ani should be picked up with dissecting forceps, transfixed, the needle encircling superficially around the rectovaginal septum; it should include likewise the other end of the torn sphincter. The torn ends should be carefully coaptated by two or three sutures.

If the rectal wall is involved, it is closed by introducing sutures from the outside, which should not enter the gut. The needle enters and issues on the wounded surface of the rectum (Lowenstein suture), the knots being buried by the next line of suture. Working in the depth of the wound, a small curved needle armed with catgut No. 1 is best. If the rectal tear has been extensive, a second series of buried sutures may be best to fortify the first. The wound thus having been transformed from a complete into an incomplete laceration, the latter is closed as outlined above.

Very rarely a laceration occurs directly through the perineum, leaving the vulva and perhaps the anus intact. This is called a *central rupture or laceration of the perineum*. In case of such an unusual accident the treatment

would consist in cutting the bridle of tissue of the vulva remaining and then closing according to the principles of the usual laceration.

Episiotomy, incision of the vulvovaginal outlet, may be indicated when extensive laceration of the perineum seems imminent. This gives as a wound a clean cut instead of a ragged tear. Incision is made with heavy, blunt-pointed, straight scissors, from slightly to either side of the midpoint of the posterior commissure, in a line directed midway between the anus and the ischial tuberosity of the corresponding side. The extent of incision must be judged by the disproportion, but should be sufficient to allow ready exit of the head.

Suture of the wound should be done immediately and according to the general surgical principles of perineorrhaphy. The parts should be restored to their normal relations by suture upon both vaginal and skin surfaces, the junction of skin and mucous membrane serving especially as a guide. Sutures should be passed sufficiently deep to avoid dead space. If the wound is extensive, especially when involving fibers of the levator ani, the depth should be closed with buried sutures as a first step in the procedure.

If the steps of the operations just described are aseptic, the management of the puerperal state does not differ materially from the normal. It is unnecessary to administer vaginal douches, since the non-septic lochia will not interfere with union. It is not good practice to keep the bowels constipated. The perineal tear is more likely to heal from the depths if we prevent hardened fecal matter from collecting in the rectum. The coaptated surface may be kept powdered with **aristol** or **boric acid**, and

the nurse should be strictly enjoined to exercise scrupulous cleanliness of the external genitals.

Delayed Operation.—When primary or intermediate operation has been omitted or has failed, a plastic one, or *secondary operation*, is necessary for restoration of the pelvic floor. These operations should not be undertaken until from six to twelve months after the original injury. During this interval the general health of the patient should be looked after.

The operative procedure will vary according to the preference of the operator and according as the laceration is partial or complete. *The resection and suturing must be adapted to the tear.*

A multitude of **plastic perineal operations** have been described, but all are based either upon the classic operation of Lawson Tait or that of Emmet, the former being a flap-splitting procedure, the latter a denudation or resection as a preliminary to suture.

Tait's Operation.—No tissue is removed. In incomplete tear, the rectovaginal septum, with sharp pointed scissors, is split from side to side, the depth of this wound perhaps two centimeters. The wound is extended forward on either side, somewhat less deep, to the point where the operator estimates the posterior commissure should be. This forms a semicircle along the muco-cutaneous junction. The upper or vaginal flap is drawn upward by means of a tenaculum and the depth of the wound increased as may be necessary.

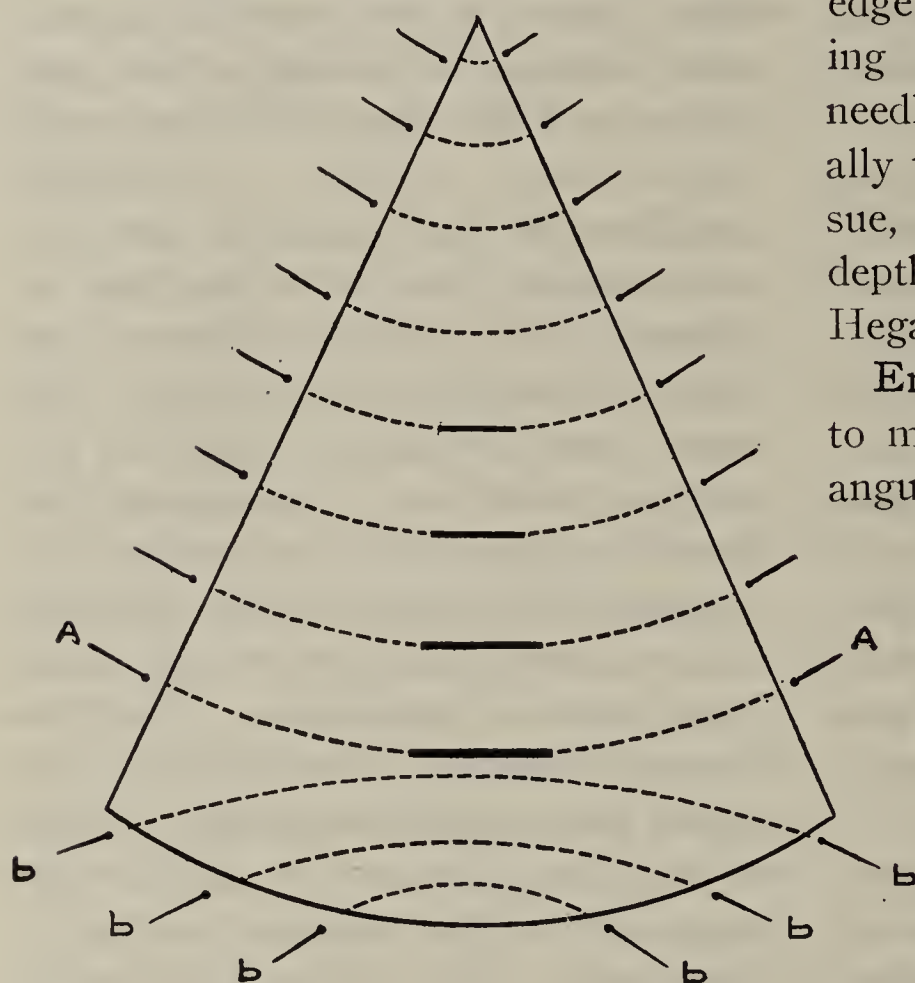
With a moderately curved needle, beginning nearest the anus, the sutures are passed transversely, entering and emerging near the edge of

the wound, the skin not being included. The sutures are concealed throughout. It may be necessary to introduce a finger into the rectum as a guide. Four sutures are generally sufficient. It is recommended that the skin edge be closed with superficial sutures.

In complete laceration, on either side of the transverse incision which splits the rectovaginal septum as described above, a downward and backward incision is carried, which goes just beyond the edges of the separated sphincter-ani muscles. A marked dimpling on each side of the anus shows plainly the location of the retracted ends of the sphincter ani, when the laceration is complete. The points must be denuded and the sutures so placed as to bring and hold them in apposition until union has occurred. The flaps of this H-shaped incision, held apart, upward and downward, form a quadrilateral. The first suture, beginning from behind, is inserted just outside and below the edges of the torn sphincter ani and brought out exactly at the same spot on the opposite side. The stitches are then introduced and tied as in the incomplete operation. It will be found necessary to introduce a certain number of superficial sutures into the perineum or along the vaginoperineal commissure, if we wish to secure perfect cutaneous union. In complete lacerations, there is more certainty of securing a perfect restoration of function of the sphincter-ani muscle and in preventing the formation of a recto-vaginal fistula than with most other methods.

In some cases, in which the laceration has been moderate and central, a simple **triangular resection** of the

vaginal wall is sufficient preparation for suture. From the base of the triangular resection extending from side to side in front of the anus, along the junction of the skin and mucous membrane, the denudation should reach up the posterior vaginal wall above the tear. In this way resection beyond the limits of the scar tissue will be secured. The area to be resected should be grasped and fixed and put



Insertion of sutures. A, A, intravaginal sutures; b, b, external sutures. (After Hegar.)

on the stretch with tenaculum forceps, one at each angle. The two forceps below should be opposite the point where it is desired to construct the posterior commissure of the vulva. Resection may be done by removing successive strips with curved scissors, or, following incision along the muco-cutaneous junction, a flap of the mucous membrane to the full extent of the denudation desired may be dissected from below upward, using the finger covered with a piece of gauze, the flap then being cut off. The sutures

passed from side to side succeed one another from above downward about one-fourth inch apart, until the site of the commissure is reached. The remaining series of sutures from the skin surface should be begun nearest the anus, ending at the commissure.

Each suture, throughout, should enter on the mucous membrane or skin about three-eighths inch from the torn edge and should issue at a corresponding point on the opposite side. The needle should take a wide sweep laterally to gather up a good portion of tissue, and should go entirely beneath the depth of the wound. (See figure after Hegar.)

Emmett's operation is best adapted to many cases, because the double triangular denudation, an angle extending up each sulcus of the vagina, corresponds to the original tear. Even though the laceration has not always involved the vaginal sulci, the case is best fitted to one (there being many of them) in which a considerable rectocele exists. It is adapted to either an incomplete or a complete tear.

The area to be resected should be put upon the stretch with at least three tenaculum forceps. A forceps grasps the muco-cutaneous junction at a point opposite to the caruncle on either side. Another forceps should grasp the posterior vaginal wall at a midpoint high up, the height being best determined when, by moderate tension, the tissues may be drawn downward and forward approximately to the external meatus of the urethra. A fourth forceps may grasp the posterior commissure.

The base of the resection is formed as outlined in the operation described

immediately above, but by the extension upon the posterior vaginal wall the apices of two triangles are formed, one extending into each lateral vaginal sulcus. Resection should be sufficiently deep and wide to expose underlying fasciæ and muscles involved.

In *complete tear*, particular care must be exercised to expose the ends of the torn sphincter ani, which ends must be brought into coaptation, else the operation will be a failure. Suture of the sphincter and, when involved, of the rectal wall, should be accomplished as described in primary or intermediate repair.

From two to four interrupted sutures should close each vaginal sulcus, beginning at its apex. Each suture, introduced on undenuded surface, including a good "bite" of tissue, should be inserted from above downward toward the median line of the sulcus, brought out at this point, reintroduced upward, and make its exit at a point corresponding to its entrance. On tying, these sutures not only draw the tissues toward the median line, but lift them to a higher level nearer their normal position. Each sulcus thus having been separately closed, the "crown suture" is passed through the three points grasped by the tenaculum forceps. When tied, this suture brings these tissues together in apposition to form the posterior commissure. The needle, in passing this suture, should not enter the wound, but should completely encircle its depth. The wound below, appearing on the skin surface, now remains to be closed to form a part of the skin perineum. Sutures are passed from side to side, sufficiently deep to avoid any dead space beneath.

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PROCTITIS. See RECTUM AND ANUS, DISEASES OF.

PROCTOCLYSIS. See SODIUM: SALINE SOLUTION.

PROGRESSIVE BULBAR PARALYSIS. See BULBAR PARALYSIS.

PROGRESSIVE OSSIFYING MYOSITIS. See MUSCLES, DISEASES OF.

PROGRESSIVE SPINAL MUSCULAR ATROPHY. See SPINAL CORD, DISEASES OF.

PROSTATE, DISEASES AND INJURIES OF. See URINARY SYSTEM.

PROTARGOL. See SILVER.

PROTEIN SENSITIZATION.

—This term is applied to a condition in which the individual is physiologically sensitive or hypersusceptible to some foreign protein. Four types of protein have been studied more or less extensively in this connection: bacterial, plant, animal and food protein. It has been found that these may act separately or in combination. Thus, in bronchial asthma bacteria may act alone in the causation, or be in combination with a plant pollen protein or one or more food proteins, and in some cases also with an animal protein.

The protein may find ingress to the body in various ways: By ingestion, inhalation, absorption and infection—by ingestion through the digestive tract; by inhalation through the respiratory tract; by absorption through any abraded surface, as the skin or conjunctiva; by infection from any pathogenic bacteria lodged in various parts of the body, especially in the tonsils, teeth, lungs, nose, throat or intestines.

The poison produced by the protein is disseminated by the blood throughout the entire organism, where it produces definite reactions in the parts where absorption has taken place. We do not know why these special tissues act in this way and can merely ascribe it to an individual idiosyncrasy.

Diseases Caused by Protein Sensitization.—The most common diseases caused by protein sensitization are: hay fever, bronchial asthma, and various skin conditions, such as eczema, urticaria and acne. Furthermore, numerous digestive troubles in children have been found to be due to this condition, and so called acidosis or acid intoxication, in certain instances, has been proved to be so caused.

Hay fever is most commonly caused by the protein pollens of ragweed, goldenrod, red top, golden glow, sunflower, timothy and corn; bronchial asthma, by the emanation of horse hair, horse dander, dog or cat hair or rabbit fur, goose or chicken feathers. In some cases pollens are the primary cause, while bacterial proteins continue the condition; again, it has been found that bacterial proteins are the only cause. When the latter is the case the bacteria at fault are the *Staphylococcus pyogenes albus*, the *Streptococcus hemolyticus*, the *Staphylococcus pyogenes aureus*, and the *Micrococcus catarrhalis*.

In the inhalation type there are 4 sources, namely, 1, animal hair and dandruff; 2, pollens; 3, flour, and 4, dust. In the ingestion type there is but 1 source, namely, food. The chief food offenders in order of importance are, 1, cereals, such as wheat, corn, rice, rye; 2, eggs; 3, fish, such as lobster, salmon, mackerel, and cod;

4, casein; 5, beef; 6, chicken; 7, cocoa. Walker's proportion of the various causative factors is 20 per cent. sensitive to horse dandruff, 15 per cent. to wheat, 15 per cent. to *Staphylococcus pyogenes aureus*, 15 per cent. to early pollens, 10 per cent. to late pollens, 5 per cent. to cat hair, 3 per cent. to *Staphylococcus pyogenes albus*, and 17 per cent. to miscellaneous proteins. C. N. Hensell (Minn. Med., Apr., 1920).

Skin diseases are caused by the following food proteins in the greatest number of cases: tomato, strawberry, fish, egg white, shell-fish, almond, beef, wheat, milk, pork, oats and buckwheat.

The digestive disorders of children are caused by many different food proteins, the most common being: carrot, pork, plum, asparagus, squash and cocoa; to a less extent, beef, barley, rice, oat, pea, string bean, tomato, pineapple, egg, banana, peach, fig, strawberry, peanut, celery, corn, and lima bean.

Sensitization Test.—The two methods employed in testing for protein sensitization are the intradermal and the cutaneous. The former is not used as extensively as the latter, as it is more difficult to perform and is often quite painful; the cutaneous method is much easier, and not at all painful, while the reaction is quite as positive.

The cutaneous test is performed as follows: Beginning just below the bend of the elbow, on the inner side of the forearm, a scarification about one-fourth inch in length is made with a small sharp knife into but not through the skin. A small portion of the protein to be tested is placed over the cut, and if a dried protein is used a drop of decinormal

sodium hydroxide solution is rubbed in, using a sterile toothpick; this facilitates absorption. If a protein in solution is used, the decinormal sodium hydroxide solution is not employed. The scarifications should be at least one-half inch apart. Two lines of these scarifications are made on the arm to the wrist, care being taken to tabulate each one carefully as it is done, so that no mistake will be made when it is time to read the results. At the end of 25 to 30 minutes each one is cleansed with warm water and cotton, being careful not to rub hard.

If there is any reaction it will, as a rule, be apparent at the end of 30 minutes, though delayed reactions have been reported, some not occurring for over 24 hours. The typical reaction takes the form of an urticarial wheal or white elevation about the site of the scarification. The larger and more irregular in outline it is, the more marked the reaction. At times there is a red areola surrounding it. Lesser reactions occur where the wheal is smaller and quite regular in outline, but these must not be discarded as they are still positive, though to a less extent. Any reaction that measures 0.5 cm. in diameter should be considered positive. The reading of these reactions is by far the most important part of the test, and because some men have been unable to do so they have gotten poor results. It is far better to say that a questionable reaction is positive than to err on the other side and take only the most marked reactions as positive.

Desensitization.—This is accomplished by the hypodermic injection of minute doses of the protein to

which the patient reacts. The initial dose should be so small that no reaction occurs after its administration, this being determined by intradermal or cutaneous tests of solutions of known strength. One finds in this way which strength gives no reaction, and this one is used for the first treatment.

The treatments are given every week, the dose being increased each time. The number of doses varies greatly in individual cases, according, in most instances, to the size of the initial dose that the patient can take.

This method is best used for the pollens and the animal and bacterial proteins, while it does not act well in the case of food proteins. It is better to remove the offending food entirely from the diet for some months at least and then test again, when, if the reaction is less, small amounts of this food should be given at decreasing intervals.

Case Reports.—Medical literature is filled with reports of cases of hay fever, asthma and skin conditions due to protein sensitization, but little has been found therein regarding the gastrointestinal conditions in children; therefore, a few such cases are submitted herewith, those associated with acid intoxication having been reported by M. A. Ramirez (New York Med. Jour., Sept. 21, 1921) and the other by the writer of the present article (Archives of Pediat., May, 1922).

CASE 1.—Male, 2½ years. Attacks of cyclic vomiting and acidosis about every six weeks for one year. Positive reactions to carrot and spinach. These were removed from his diet and in 18 months he has had no return of the attack. He has gained much in weight and strength. Has

recently had influenza and scarlet fever with no bad results and recovered from these diseases more quickly and in better condition than did a sister and brother.

CASE 2.—Female, 3 years. For 8 months, frequent digestive disturbances associated with vomiting and acidosis. Reacted positively to carrots, lettuce and rice. The removal of these foods was followed by absolute relief. Two months after the tests were made she had soup in which one carrot had been cooked, unknown to her mother, and in two days she had a slight return of vomiting, which lasted only 1 day. Since then there has been no return in the year which has elapsed.

CASE 3.—Female, 2 years. Four attacks of vomiting associated with acidosis, serious in character. Reacted to carrots, pork, barley and rice. For 2 months she had no attack, but while visiting relatives she ate some of the positive foods and 3 days later had an attack of moderate severity; during the succeeding 5 months there has been no return and her health is normal in every respect.

CASE 4.—Male, 3½ years. Always a weak child; poor development, pale, always tired, diarrhea alternating with constipation; abdomen large, much gas, separation of recti muscles—the typical picture of malnutrition. Reacted to beef, barley, corn and plum. In the 6 months following the removal of these foods from his diet there has been no return of his symptoms. He has gained 6 pounds in weight; color good, muscles strong, abdomen normal, and he has lost his irritableness.

CASE 5.—Male, 9 years. Always a sickly, undernourished child, with much difficulty in feeding owing to frequent attacks of indigestion associated with acid intoxication. Reacted positively to tomato, onion, asparagus, squash and beef. The tomato reaction was + + +. It was found that on the evenings preceding the last 2 attacks he had eaten tomato either in soup or as a vegetable, and the symptoms occurred within 12 hours. No attack has occurred in the last 6 months.

CASE 6.—Male, 6½ years. A difficult feeding case since birth. Frequent gastrointestinal upsets associated with acidosis. Positive reactions were obtained to carrot,

peach, plum, fig, squash and tomato. In the year preceding the test he had only gained 1 pound in weight. He has gained 4 pounds in the 5 months since these foods have been removed from his diet.

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PROTEIN THERAPY, NON-SPECIFIC.—Time has severely shaken the theory of strict specificity in its relations to immunity. Even vaccines have departed materially from the beaten path in this direction, non-specific vaccines used in intravenous injections in typhoid fever, for example, having given just as good results as specific vaccines. Proteins, peptones, deuto-albumoses, bacteria, etc., have all shown, by the similarity of their reactions, that non-specificity must be reckoned with in the future. Even Wright had to acknowledge its influence when, in using antipneumococcus inoculations in the Transvaal, he observed, besides a large reduction of the mortality from pneumonia, a reduction of 50 per cent. in the mortality from other infections. Upon this principle is based non-specific protein therapy: a foreign protein, sterile albumose solutions, horse serum, sodium nucleinate, bacterial proteins, or colloidal metals being injected intravenously, and milk intramuscularly, to provoke a reaction of the body's defensive powers.

Physiological Action.—As is the case with all therapeutic measures which involve the defensive processes of the body today, the prevailing theory of immunity explains but few of the phenomena observed, leucocytosis, the appearance in the blood of non-specific proteases and lipases,

an unduly rapid formation of antibodies, a perversion of defensive ferments, the formation of antiferments, etc., having all been tentatively adduced as possible explanations. This is due to the prevailing ignorance of the defensive functions of the ductless glands, which functions are described in the first volume of the present work and to which the reader is referred (see *Animal Extracts*, Volume I, p. 687 *et seq.*). There has been observed an active proliferation of granular neutrophils and, in some cases, an increase of red corpuscles.

Untoward Effects.—At first, typhoid bacterins were tried intravenously, but their use was often attended by shock with chills, fever, and other untoward symptoms. Other agents likewise produce reactions. Carefully sterilized milk was then tried by intramuscular injection. This proved the least likely to produce a violent reaction, yet caused invariably a rise of temperature of from 2° to 5° F., lasting about twenty-four hours, and an active leucocytosis, a slight rigor with occasionally muscular twitchings, and very rarely shock. An overdose might give rise to cyanosis, dyspnea, shock and diarrhea. Cyanosis and dyspnea were found by Gow to be promptly relieved by the hypodermic use of **adrenalin** or **atropin**.

The unfavorable manifestations that sometimes follow the parenteral use of proteins are as follows: A few minutes after the injection, cyanosis, dyspnea, small pulse, occasionally unconsciousness, transient edema and transient erythema; a few hours after the injection, chills, fever and outbreak of sweat. Cachexia, which may follow the parenteral administration of large amounts of protein, is occasioned by the overproduction of

proteolytic ferments. Van Randenborgh (*Zentralbl. f. Gynäk.*, Oct. 2, 1920).

At Cook Country Hospital, Chicago, at least 2,000 intravenous injections of typhoid vaccine have been given in the treatment of various acute infections without serious consequences. The only untoward results observed were the development of delirium tremens in confirmed alcoholics. The treatment was not administered to enfeebled patients, however, or to those with disturbed heart action. Whether there is advantage in the use of a larger dose of protein than that necessary to excite a chill has not been determined. The use of such large doses would probably increase the danger attendant on the treatment. J. L. Miller (*Jour. Amer. Med. Assoc.*, lxxvi, 308, 1921).

Mode of Administration.—For intravenous injections, Merck's 4 per cent. albumose solution, giving 1 to 2 c.c. daily, adjusting the dose to that just sufficient to produce a chill, or typhoid vaccine preserved in 0.5 per cent. phenol, or a stock solution, are employed. These, or the intramuscular injections of milk, may be made in the gluteal muscles or in those of the back or arm. The condition, strength and age of the patient should, of course, regulate the dose.

As to the milk injections, the dose varies from 5 to 20 c.c. (1¼ to 5 grams). The severity of the reaction corresponds in a measure with the size of the dose. A second injection may be given after the local and general reactions, including the leucocytosis, have subsided, *i.e.*, in from 2 to 5 days. A carefully asepticized and graded syringe should be employed. Some authors have used daily injections where a negative phase does not appear.

It has been shown that no negative phase, so far as the antibody content of the blood is concerned, follows the injection of foreign protein. For this reason daily injections seem justifiable. On the other hand, if the severity of the reaction and the patient's condition are taken into consideration, it is good practice to allow a day to intervene between the injections. If any benefit is to be secured by this method of treatment, from 1 to 10 injections are sufficient. No anaphylactic shock phenomena accompany the injections, even though a second course of treatment may be given after several months. Sterile albumose solutions, horse serum, and bacterial proteins bring about similar results. D. M. Cowie (Jour. Amer. Med. Assoc., lxxvi, 310, 1921).

Contraindications.—Uncompensated cardiac lesions and acute endocarditis or pericarditis are regarded as contraindications. Renal disorders do not seem to contraindicate the use of sterilized milk, although a slight increase of albumin might suggest the opposite. Even when a few casts also appear, these effects are ephemeral.

Therapeutics.—The injections should be started as soon as possible after the presence of a morbid process or infection is recognized. So far, the number of carefully controlled observations has been relatively small. What has been done in this line, however, tends to indicate that we are dealing with an important therapeutic method.

The whole problem is still too little developed for exact rules. Yet, in selected cases good results may be secured in many different diseases. At present it is merely a question of collecting the observations of various investigators and the results of further experimental study before the method can be made available for general practice. F. E. R. Loewenhardt

(Zentralbl. für innere Med., Apr. 2, 1921).

The writer tried protein therapy in infants, using white of egg, breast milk or other substances in the treatment of various pathologic conditions. The results were disappointing, due probably to the inadequate development of the defensive forces at this age. Actual benefit was realized only in **gonococcus infection** and **pyodermitis**. Slawik (Jahrb. f. Kinderheilk., xciv, No. 3, 1921).

In **arthritis**, particularly acute, subacute, and peri-arthritis, protein therapy has been very efficient, though often evanescently so unless any focus of infection that may be present be removed.

While the writer regards intravenous protein therapy as of great value in certain carefully selected cases—more particularly of **arthritis**, the **septicemias** and **coliform infections**—he states most emphatically that it is not a panacea for all ills; and even in those diseases in which it is of use it is to be regarded solely as an accessory weapon in conjunction with, not in place of, other remedies. Gow (Brit. Med. Jour., Feb. 28, 1920).

In **typhoid fever** the results have been favorable, irrespective of the kind of foreign protein used, crisis occurring after 1 to 3 intravenous injections in about 20 per cent. of all cases, and rapid lysis in an additional 20 per cent., with noticeable shortening in a third 20 per cent., thus leaving 40 per cent. of cases unaffected. **Typhus** and **puerperal sepsis** and **pneumococcus** and **influenzal pneumonia** may be mentioned among the acute infections in which good results have been reported.

The writer treated 350 cases by intravenous injections of deuterio-albumose, 35 of the cases being **typhoid fever**, with but 2 fatalities and without hemorrhage or perforations or car-

riers. His method of procedure was different from that ordinarily employed in protein therapy, as he gave a small daily dose until the temperature reached normal. The temperature reaction was very slight. The termination by crisis did not occur, but the patient became less toxic and the course of the disease was shortened. As these patients were all soldiers, it is presumed that they had previously received antityphoid inoculation. This might be somewhat of a factor in the low mortality. The fear of hemorrhage, formerly suggested, is apparently not warranted. G. Holler (*Beitr. z. Klinik der Infect. Krankh.*, vi, 92, 1917).

The writer tried fresh and boiled milk, including milk from the market which had been boiled 4 minutes. The latter as a rule caused chills, malaise and high transitory fever and locally swelling, sensitiveness and pain. Fresh milk gave similar results, but much milder. The total number of cases treated was 38. One group of 8 cases comprised miscellaneous infections—**scarlet fever, erysipelas, acute rheumatism, prostatitis, pyelitis**, etc. Save for 2 cases of scarlet fever, the material all showed rapid fall of temperature and subjective improvement. The second group comprised 30 cases of **influenza**. In 16 there followed within 3 days fall of temperature and improvement. In 5 the improvement followed promptly upon the first injection and recovery after the second injection. Apparently the parenteral injection of milk is of benefit in benign uncomplicated infections, cutting short the process to some extent; but there is no evidence that it possesses any power for good in severe and complicated infections. Bratt (*Hygiea*, Mar. 31, 1920).

Parenteral injection of milk was tried by the writer in 36 obstetric and 21 gynecologic cases. It seemed to accelerate recovery in certain cases and ward off serious disturbances, but when severe puerperal septicemia was under way no benefit could be detected. Under any conditions the ef-

fect did not much surpass that from the ordinary measures, drugs, vaccines, fixation abscess, mercuric chloride by the vein, etc. But the harmlessness of this milk form of protein therapy, its availability, and its excellent influence in reducing objective and subjective pain and in enhancing the defensive powers of the organism impose its use on a large scale, especially during the early stage. Bianchi (*Riforma Medica*, Nov. 6, 1920).

In **puerperal sepsis** the writer used 10 Gm. (2-½ drams) of Witte's peptone, about 5 c.c. (1-¼ drams) of hot freshly distilled water, and the volume made up to 100 c.c. (3⅓ ounces). The first dose which may be given intravenously to a septicemic adult is from 8 to 10 c.c. (2 to 2½ drams). The quantity is increased by 2 c.c. (½ dram) every other day or so until 16, 18 or 20 c.c. (4, 4½ or 5 drams) are given at a time. The injection must be made slowly, using a record syringe and a very fine bore needle with a No. 28 it is impossible to introduce the solution too rapidly. In cases of puerperal septicemia the injection of peptone tends to cause an immediate and rapid fall in blood pressure, a rise in the pulse frequency, and if the patient has a leucocytosis, it rapidly induces a high degree of peripheral leucopenia—all these phenomena being of very short duration. But it does not always bring a septicemia to an end. Gow (*Brit. Med. Jour.*, Aug. 21, 1920).

Protein therapy had no apparent effect in 9 cases of pneumonia or influenza treated by the writer. In 12 typhoid cases the injections seemed to aggravate conditions, inducing shock and intestinal hemorrhage. No effect was apparent, further, in chronic tuberculosis of any form, nor in 2 cases of athrepsia. In 2 cases of ozena the results were very fine at first, but transient. He warns that there may be congenital as well as acquired intolerance for milk, and that this should be borne in mind. Silvestri (*Riforma Medica*, Feb. 19, 1921).

Parenteral milk injections seem to be giving good results in **ophthalmology**, particularly in **acute iritis** and other diseases due to local infection.

Parenteral injection of milk has won an important place in the treatment of the eyes. The results of other substances have not been so reliable as with 5 c.c. ($1\frac{1}{4}$ drams) of milk, boiled for 4 minutes. The protein shock that results has proved particularly effectual in **acute iritis**. From the very first injection the pain is relieved. In **gonococcus conjunctivitis**, the secretion declines and local measures are then more effectual, and coincident **vulvo-vaginitis** subsides also. After an operation on the eye, injection of milk is useful in prophylaxis of infection. This wards off exudation. The reaction is not evident until the fourth hour. The temperature then runs up to 38.5 or 40° C. (101.3 to 104° F.) and keeps high for about 2 hours. The next day there are usually a little headache and loss of appetite. The course is generally 3 or 4 injections at intervals of 1 day. Coppez (*Médecine*, Jan., 1921)

Injection of milk has given surprising curative results in the most severe suppurative lesions of the eye. In reporting 2 cases the writer states that most authorities agree that the quantity of milk injected should not be over 10 c.c. ($2\frac{1}{2}$ drams) given daily or every other day. Prolonged boiling or heating to a temperature above 120° reduces the therapeutic power. Only fresh milk previously heated to boiling for 4 minutes should be used. Three to 5 injections are sufficient in most cases. R. Arganaraz (*Semana med.*, xxvii, 57, 1921).

The intragluteal injection of milk has given good results in **gonorrheal arthritis**, both subacute and chronic, the improvement depending, however, upon the intensity of the reaction. The acute cases are less advantageously influenced.

The writer records favorable results in 60 cases of **epididymitis** treated with milk injections. He particularly advises the procedure in cases of **bubo** to those who desire to get an idea as to what may be attained by this treatment. R. Müller (*Deut. med. Woch.*, May 16, 1918).

In 1 military cantonment where intravenous injections of gonococcal protein were used in **gonococcal epididymitis** the results were most gratifying. The cessation of pain was nearly always complete within 24 hours after a properly reacting protein injection and the average stay in the hospital was 5 or 6 days. At the end of this time there was usually a marked reduction of the local swelling, beginning with the subsidence of the pain. In some instances of gonorrheal epididymitis it was necessary to give a second injection to obtain the desired results. There were 2 distinct groups of such patients. One apparently derived no subjective or objective benefit from the first injection but responded well to the second from 24 to 48 hours later, while the other group obtained relief after the first injection, but the effect was only temporary. In some instances members of the second group also obtained complete and permanent relief after a second injection. If the second injection was not beneficial, it was thought best not to continue the treatment. H. Culver (*Jour. Amer. Med. Assoc.*, lxxvi, 311, 1921).

Various cutaneous diseases of a chronic type, notably **psoriasis**, **eczema** and **pyogenic disorders** of various types, **impetigo contagiosa**, **trichophytosis**, and **fungoid disorders**, have also been favorably influenced.

As is pointed out in the corresponding articles in this work, certain acute paroxysmal states, such as **urticaria** and attacks of **asthma** and **migraine**, are traceable to hypersensitiveness of various nerve cells or centers to certain protein substances. According to

Widal, Abrami, and Brissaud, oral use of peptone is valuable as a prophylactic against these acute attacks.

Giving peptone by the mouth is a very simple harmless method of warding off attacks of **urticaria**, **migraine**, or **asthma**, annulling the action of the unknown substances responsible for their development. Complete desensitization may be obtained by prolonged use of the peptone. If this fails, other proteins might be tried by subcutaneous injection, or even certain crystalloid substances with which the writers have been successful. Protein therapy by shock is not yet ready for general use, notwithstanding the brilliant success obtained in some cases. Widal, Abrami and Brissaud (*Presse méd.*, Mar. 5, 1921).

C. E. DE M. SAJOUS,
Philadelphia.

PRURIGO (*Juckblattern*; *Strophulus pruriginex*).—Prurigo is a chronic disease showing small, pale or reddish and isolated, deeply seated, or slightly elevated papules, accompanied with intolerable itching, thickening and pigmentation.

Two types are distinguished—prurigo ferox (severe prurigo) and prurigo mitis (mild prurigo)—according to the severity of the disease. The disease usually begins in the first year of life, sometimes simulating urticaria. Later discrete, firm papules, pinhead in size, or larger, appear upon the extensor surfaces of the extremities, the trunk, and sometimes upon the forehead, being either pale red or the color of the skin. As a result of the intense itching, the affected areas become covered with scratches and blood-crusts. Later the skin becomes harsh, dry, much thickened, and occasionally pigmented. Exaggeration of the natural furrows of the skin, as a rule, follows. There is an enlargement of the neighboring lymphatic glands. The disease is very rebellious to treatment and may persist throughout an entire lifetime. The disease is very rarely seen in the United States except in immigrants, chiefly in those from Austria.

ETIOLOGY AND PATHOLOGY.—This disease is the result of poor food and bad hygiene and is generally limited

to the poorer classes. Tuberculosis has been named as a causative factor.

The minute changes are those of a chronic inflammation and are almost identical with those of chronic papular eczema.

TREATMENT.—This should be directed toward the relief of the itching, the cure of the eruption, and the improvement of the general health. For the relief of the itching Crocker recommends the **tincture of cannabis indica**, beginning with 5-minim (0.30 c.c.) doses in a child of 8 years, and increasing to the physiological limit. **Ointments of betanaphthol** (2 to 10 per cent.), **sulphur** (1:8), and of **tar** (50 per cent.) are also used for the itching. **Wilkinson's ointment** (unguentum sulphuris comp., N. F.) is valuable. In 8 children Dobrowsky observed that **thyroid extract** relieved the itching and cured the eruption. **Baths** exert a favorable influence—the **alkaline bath**: **sodium bicarbonate**, 4 ounces (125 Gm.) to 30 gallons (120 liters) of water, and the **sulphur bath**,—precipitated **sulphur** or **potassium sulphide**, 4 ounces (125 Gm.) to 30 gallons (120 liters) of water.

Nutritious food and **proper hygiene** with tonics (**iron**, **codliver oil**, and the **hypophosphites**) are always indicated. In this disease arsenic has little or no value.

W.

PRURITUS.—Pruritus is a functional cutaneous disorder, a form of perverted cutaneous sensation, characterized by an itching, tingling, burning, creeping or pricking sensation without structural alteration of the parts. The itching of pruritus is the essential feature, and is not related to any primary cutaneous lesion. It is a distinct affection and must not be confounded with prurigo or any other disease of which itching is one of the many symptoms.

SYNONYMS.—Itching of the skin, paræsthesia.

SYMPTOMS.—The primary symptoms are entirely subjective, of which the first and only one may be the sensation of itching, pricking, formication, or boring, the intensity of which varies within wide limits. It may be slight and transitory, or it may be so severe and persistent as to render life almost unbearable. Waugh

cites a case in which a man walked into his office, laid a revolver on the table, and remarked that he would shoot himself then and there if the physician did not relieve him of his pruritus (anal). Pruritus may be intermittent or constant, general or local; in most cases it comes on in paroxysms, but in the worst cases it is almost constant. It often comes on when the patient is warmed up in bed, and may interfere with sleep. It attacks the skin or the mucocutaneous orifices. In old persons it is prone to appear on the trunk or extremities, in the axillæ, the anus, or the vulva. Not infrequently it affects the legs from the knees to the ankles. Winter pruritus (*P. hiemalis*) especially favors the inside of the thighs. In the effort to obtain relief by rubbing, scratching, or pounding the parts, secondary lesions of the skin are produced.

The secondary cutaneous lesions from the scratching, rubbing, etc., are erythema, roughness, abrasions, lymph-papules and linear wounds showing the track of the nails (Shoemaker). An eczema is not infrequently produced which masks the underlying condition (Schamberg).

VARIETIES.—When the itching is generalized it is called *pruritus universalis*, although it seldom affects the entire cutaneous surface. Diffuse itching is most frequently met with in old persons whose skin is the seat of incipient senile changes; it is then called *pruritus senilis*. Examples of localized itching are seen in *pruritus ani*, *pruritus scroti*, and *pruritus vulvæ*. In the latter the scratching and the pleasurable relief following may pave the way to masturbation. A form of this disorder occurring in the cold weather is called *pruritus hiemalis*, or winter itch. In young adults with dry skin itching sometimes appears after bathing (bath pruritus).

DIAGNOSIS.—Care must be exercised in the diagnosis of this disorder, as many of its morbid sensations resemble those in other cutaneous affections. Of chief importance in the diagnosis are the history of the case, an irritation without any initial eruption, and, perhaps, the appearance, later, of secondary changes—excoriations, crusts, an infiltrated and reddened skin with congested and torn follicles. It may be difficult, when eczema or derma-

titis are complications, to fix upon the primary ailment, especially in the localized forms of pruritus, and one must rely upon the history and subjective symptoms.

Prurigo is sometimes confounded with, or is indeed, at times, called pruritus; but, although it is a source of itching, it is a papular affection, and runs a different course from that of pruritus.

Pediculosis, urticaria, eczema, especially when mild; scabies, ringworms, etc., must be differentiated by the history of the case and by careful examination. One of the rare symptoms of locomotor ataxia is periodical pruritus limited to the lower limbs; the attacks are fugitive, lasting two or three days, and are relieved by hypodermic injections of morphine. With this pruritus of locomotor ataxia are observed inco-ordination of the lower extremities, loss of reflexes, Argyll-Robertson pupils, vesicular paralysis, gastric crises, and other pathognomonic symptoms.

ETIOLOGY AND PATHOLOGY.—

Pruritus, or paresthesia, is usually a functional disorder of the sensory nerves of the skin; it may be caused by functional or organic nervous disease, or by nutritive or metabolic disorders, through their action on the sensory nerves, a hyperesthesia being induced. Among the acknowledged causes of pruritus are the various psychic neuroses, neurasthenia, the uric acid diathesis, diabetes, Bright's disease, utero-ovarian disorders, pregnancy, indigestion, constipation, and hepatic disorders; tobacco, coffee, tea, opium, alcohol, etc., if excessively used, may be etiological factors.

Degenerative cutaneous changes in the aged are an accredited cause of senile pruritus. Pruritus ani is generally due to a local irritation from hemorrhoids, fistula, fissure, or intestinal worms, and less often to constipation, lithemia, etc. Pruritus scroti is very common among tailors, whose cross-legged position at work favors congestion of the parts; by reflex action vesical calculus and urethral stricture have been responsible. Pruritus vulvæ may result from uterine disease, pregnancy, and from leucorrhœal and other discharges; it is very frequently present in diabetics. The pruritic habit may be left after eczema and pediculosis have disap-

peared. The action of cold on the peripheral nerves produces pruritus hiemalis in susceptible persons.

PROGNOSIS.—This is good when the cause can be removed. Many patients are cured, although the duration of the disease may be rather long; considerable relief can be given in nearly all cases.

TREATMENT.—The first indication is to remove the cause if possible. *Internal treatment* against any underlying disease—diabetes, lithemia, hepatic and digestive disorders, nervous debility, etc.—will here be necessary. Opium should be avoided, but excellent results have followed the use of **tincture of gelsemium** in ascending doses, **sodium salicylate**, **phenol**, **phenacetin**, **antipyrin**, **chloral**, **bromides**, **ammonium valerianate** etc.

The use of **woolen undergarments** should be avoided unless a thin cotton garment is worn underneath; **linen** or **silk underwear** is best.

Change of food, **climate** (warm), and **scene** are often effective in intractable cases. **Electricity**, **massage**, and **baths** at various temperatures or medicated (emollient, alkaline, **naphthol**, **alum**, **tannin**, **potassium sulphide**, etc.), are useful; the bath should be taken just before retiring for the night. **Turkish**, **vapor**, **electro-vapor** and **medicated vapor baths** of **sulphur**, **mercury**, **tar**, and of the **balsams**, are beneficial.

Locally, agents that have an anæsthetic or soothing action give much relief. **Menthol** alone, or triturated with an equal portion of **camphor**, is the favorite remedy with many, and may be used in solution or in ointment. Stellwagon suggests **menthol**, **camphor** and **phenol**, 10 to 15 grains (0.6 to 1 Gm. of each to the ounce (30 Gm.) of **benzoated lard**. Bulkley advises **chloral** and **camphor**, $\frac{1}{2}$ to 1 dram (2 to 4 Gm.) of each to an ounce (30 Gm.) of **rose-water ointment**. Bronson favors an oily application—**phenol** and **liquor potassa**, 1 dram (4 Gm.) of each to an ounce (30 Gm.) of **linseed oil**. Crocker suggests a thymol lotion—**thymol**, 2 drams (8 Gm.); **liquor potassa**, 1 dram (4 c.c.); **glycerin**, 3 drams (12 c.c.), added to 8 ounces (250 c.c.) of water.

Cider vinegar has been advocated, and also **sodium carbonate** (washing soda), 1

dram (4 Gm.) to the pint (500 c.c.) of water. Liveing's favorite ointment was: **morphine hydrochloride**, 2 grains (0.13 Gm.); **bismuth nitrate**, 1 dram (4 Gm.), and **rose-water ointment**, 1 ounce (30 Gm.), mixed.

Pruritus senilis is often relieved by an ointment of 1 part of the **oil of staphisagria** (stavesacre) to 7 parts of lard. **Phenol**, **creolin**, **creosote**, and **tartaric acid**, 1 to 20 parts of **glycerite of starch**, are also to be relied on (Shoemaker).

A well-fitting **suspensory** is advised in pruritus scroti; in obstinate cases of the latter, as well as in pruritus ani and vulvæ, Schamberg has obtained brilliant results from the use of the **X-rays**. The rays should be used only in elderly men.

High-frequency currents are beneficial in localized pruritus. W.

PRUSSIC ACID. See HYDROCYANIC ACID.

PSEUDOARTHROSIS. See FRACTURES.

PSEUDOLEUKEMIA. See LEUKEMIA AND PSEUDOLEUKEMIA.

PSILOSIS, OR SPRUE. See INTESTINES, DISEASES OF; AND MOUTH: PARASITIC STOMATITIS.

PSORIASIS. — DEFINITION.—Psoriasis is a cutaneous disease characterized by the presence of silvery-white, perfectly dry scales, which overlie a reddish, shining base.

SYMPTOMS.—The eruption of psoriasis is always dry and scaly. It begins in one or more red points, which quickly become covered with white, silvery scales. These may be readily scratched off by the finger-nail, and when this is done a bleeding surface is exposed. When many of these small, scaly lesions are present, the eruption is described as *punctate psoriasis*, and this form of the eruption is comparatively more frequent in children than in adults; when the scaly lesions increase in size and appear like drops of grease or thin mortar spattered over the skin, we have the *guttate form* of the disease; and when the patches assume the size and shape of silver coins they are often de-

scribed as *nummular psoriasis*. By healing in the center these lesions may be converted into scaly rings, or by peripheral increase and coalescence they may result in the formation of extensive scaly patches.

Though the disease is not uncommonly met in children, diffused or general psoriasis is rarely met with among them. It is not generally so well developed and so extensive as it is apt to be in later years. The amount of scaliness present in any case depends upon the attention which the patient naturally devotes to his skin. As the eruption tends to disappear, the scaling grows less, often disappearing from the center of the patch and leaving a marginate ring. Finally the redness fades and the skin assumes a normal appearance, except in certain cases, where pigmentation may occur. In rare cases of psoriasis the eruption may tend to rapidly involve the whole skin. The cutaneous congestion is severe, and large flakes of partly detached epidermis may take the place of the silvery scales.

Psoriasis is usually seen upon the extensor surface of the extremities, and is especially apt to be noted about the elbows and knees. When upon the scalp the scaly patches are apt to be small, numerous, and circular, with healthy skin intervening. The eruption upon one extremity or on one side of the trunk is usually duplicated upon the other side (Fox).

Pruritus may or may not be complained of, and the patients may be in apparently good health. Disorders of the muscles and joints are often noted, however.

DIAGNOSIS.—The diagnosis of psoriasis, as a rule, presents no difficulties; the silvery-white, perfectly dry scales are altogether characteristic. Upon the scalp it may be confounded with *seborrhea*, but the absence of inflammatory reddening and the greasy character of the scales in the latter affection will serve to distinguish it from the former.

Whether occurring in small disks or in large, irregular patches, the border in psoriasis is always sharply defined, and never shades off gradually into the surrounding healthy skin, as does the ordinary patch of *eczema*. This is a diagnostic point of great importance. In many cases

of *eczema* the patches may be dry and scaly and present a resemblance to those of psoriasis, but the rounded, silvery disks or larger marginate patches of the latter disease are usually so characteristic that an error in diagnosis is not likely to be made. While *eczema* may appear upon almost any part of the body, and often exhibits a tendency to attack the flexor aspect of the joints and other parts where the skin is thin and delicate, psoriasis, as stated, is generally seen upon the extensor surface of the extremities, and is especially apt to be noted about the elbows and knees.

An eruption resembling psoriasis sometimes occurs in *syphilis*, but the successive crops and the coalescence of lesions in psoriasis serve to distinguish it.

ETIOLOGY AND PATHOGENESIS.—Psoriasis occurs somewhat more frequently in males than in females, and at all ages, but it is most frequently met with in subjects between 10 and 30 years of age, though it is by no means rare in infancy.

Psoriasis is essentially a chronic disease. It is not a local disorder, but depends upon a general condition, which repeatedly produces the eruption.

Psoriasis of the palm is occasionally met with in cases of acquired syphilis, but usually this is observed, according to Hutchinson, in individuals whose hands are more or less irritated by friction.

A tendency to psoriasis is frequently inherited, and very often the disease may be observed in two or more generations.

Seasons seem to have some influence upon the disease, since in spring and autumn the disease often takes on an increased vigor.

Although fungi, micrococci, and other organisms have been incriminated, none showing ubiquitous specificity have been satisfactorily demonstrated. This does not mean that pathogenic organisms may not provoke the disease. The neuropathic theory has also received considerable attention; but the observations which have been adduced in favor of this theory appear to me accountable in another way—one, indeed, which also accounts for the pathogenic rôle of micro-organisms in the disease.

The writer found in fresh psoriasis areas near the borders in the upper cuticle layers, cocci groups three times, Munche's granules once, and acid-fast bacilli once. A general and local reaction was produced when treating by streptococcic vaccines, or tuberculin. He found that psoriasis patients always suffer from some kind of constitutional disease. Menzer (Deut. med. Woch., Nov. 1, 1912).

The subsquamous membrane discovered by Bulkley in the lesions of psoriasis plays the rôle of a dialyzer, separating from the lymph and blood-serum various dissociation products of the albumins and eliminating them in the form of a serous fluid. The foreign fats and lipoids described by Abderhalden in the blood may also be involved in such a process, and the writer is convinced that the micro-organismal theory of Unna and his followers should be abandoned. A. Leroy (Paris méd., Oct. 11, 1913).

Psoriasis is due to inflammation of the rete and its interpapillary projections, in which autolysis of the rete cells and their rapid replacement give rise to abnormal thickening of the horny layer and epidermal desquamation. This is ascribed by Sajous to autolysis.

Among the recognized and prominent causes of psoriasis are rheumatism and gout, the defective renal elimination accompanying the latter and digestive disturbances. In the majority of these cases psoriasis occurs as a result of defective oxidation, which entails defective formation of urates. Uric acid, as is well known, is a normal product of protein metabolism. It acts upon the neutral sodium phosphate, forming a urate and an acid phosphate, the latter of which is the essential acid of the urine. Normally there is only produced sufficient uric acid to carry on this process; when, however, defective or inadequate oxidation of the protein molecule occurs an overproduction of uric acid, which is a suboxidation product, occurs, while the output of urea falls. The process of elimination then extends to structures other than the kidney, the skin among them. Here it excites the

morbid process in locations where it happens to accumulate, forming the patches of psoriasis.

As stated by W. H. Porter (Med. Record, June 20, 1914), uric acid is a simple oxidation reduction product of protein metabolism. It requires a diminution of only 2 per cent. in the oxygen supply to double the *output* of uric acid. "Putrefactive fermentation of the foodstuffs in the alimentary canal" causes indicanuria—due to various toxics, probably *toxalbumins*. Now, these are produced through excessive eating. Even potatoes produce uric acid in large quantities.

In defective renal elimination toxics are retained in the blood. Pregnancy also provokes an addition of toxic wastes. Severe systemic disorders, alcoholism, emotions, all entail accumulation of toxics in the mucous layer or rete; their location is distinctly a process akin to abscess formation—one due, according to Sajous, to autolysis by digestive ferments, which, as shown by him and subsequently by Abderhalden, are present in tissue-cells. The local inflammation incident upon the process causes the disease.

TREATMENT.—Psoriasis being accepted as a systemic disease due to an autotoxemia of dietetic origin, reduction of the **proteins in the food**, which, owing to weakening of the oxidation processes of the patient, produce the poisons, is indicated. A strict **vegetarian diet**, which thus eliminates all meat proteins, is sometimes very effectual. The local treatment is helpful, but only of secondary importance.

Series of 140 cases of psoriasis in which the influence of a **strict vegetarian diet** was studied. Meat, poultry, fish, eggs, milk, alcohol, coffee, chocolate, and cocoa were all excluded, products of the ground being alone permitted, with the exception of butter and occasionally a very small amount of fat bacon. Analysis of the series of cases showed that 81 patients were recorded as having adhered strictly to the diet, and 24 as having been fairly faithful. In 32 patients the eruption was reported as gone and in 60 as improved. In 16 only was it recorded as not im-

proved, but, of these, 13 had not been faithful to the diet. Some of the patients, upon being seen again later, were found to have remained free from eruption. A number of others returned from time to time, after a period of unfaithfulness to the diet, with a greater or less amount of eruption. L. Duncan Bulkley (Jour. Amer. Med. Assoc., Aug. 26, 1911).

In a careful study of the protein metabolism of 8 psoriasis patients, the authors observed that on a given protein diet a psoriatic subject eliminates less nitrogen in the urine than does a normal individual on a corresponding diet. The urinary nitrogen in some of the patients reached a level lower than has ever been recorded. Patients with psoriasis exhibit a remarkable retention of nitrogen. The retention appears to be proportional, in a general way, to the extent and severity of the eruption present. The nitrogen is retained to a greater degree than has been observed in connection with any other condition and is, furthermore, retained with great ease even on a diet low in nitrogen and insufficient in caloric value, and one on which a normal individual would fail to maintain equilibrium.

Experiments with urea feedings show conclusively that the nitrogen retention cannot be attributed to any disturbance in the eliminative capacity of the kidneys. Patients with extensive psoriasis may lose very large amounts of nitrogen in the exfoliated scales, which consist of almost pure protein, but the retention of nitrogen in most of the cases was greater than could be accounted for by the protein lost in the scales, and it sometimes persisted even after scaling had ceased and the eruption had virtually disappeared.

A low nitrogen diet has a most favorable influence upon the eruption of psoriasis, particularly when the latter is extensive. There can be no doubt that severe cases of psoriasis improve under such a diet, almost to the point of disappearance of the eruption. Conversely, a high nitro-

gen diet exhibits an unfavorable influence on psoriasis, commonly causing an extension of the eruption. Whether a high nitrogen diet can stimulate an outbreak of psoriasis in a psoriatic subject, who is at the time free of the eruption, has not yet been determined.

The great proliferation and exfoliation of cells by the skin in psoriasis demands a large supply of protein, which can only be procured from the lymph and blood-streams. This protein supply may be derived from the ingested food, and a possibility exists that the great demand of the diseased skin for protein may also be satisfied by the protein reserve in muscle tissue, which thus may become depleted and later require restoration. This would explain the ready and persistent retention of nitrogen in those cases. A protracted, low protein diet may diminish the proliferative activity of the skin by diminishing the supply of the principal building material, namely, protein. On the other hand, a high protein diet may stimulate the proliferative activity of the cells by furnishing an abundant supply of the necessary protein. J. F. Schamberg, J. A. Kolmer, A. I. Ringer, and G. W. Raiziss (Jour. of Cutan. Dis., Oct. and Nov., 1913).

Jonathan Hutchinson recommends an ointment containing **chrysophanic acid**, **creosote**, **liquor carbonis**, and **ammoniochloride of mercury**, varying in proportion according to the delicacy of the skin; this must be used very freely, without regard to the underclothing or bedlinen. The regular use of a **hot bath** softens the skin and prepares it to receive the ointment.

Arsenic enjoys the confidence of some dermatologists, but, according to other authorities, it is not only useless, but in some cases it may be injurious. It fails entirely as a prophylactic. When the disease tends to improve, however, it may be of service in hastening recovery.

Fox states that of the various local remedies employed **chrysarobin** stands with-

out a rival. Like arsenic, it is most likely to do good when the acute congestion of the psoriatic patches has subsided and the eruption is tending toward a spontaneous improvement. It not only stains the skin temporarily, but it permanently discolors the underclothing and the bedlinen, if due precaution is not taken. When rubbed in where the skin is thin, or near it, it often excites a very unpleasant dermatitis for a few days; and when by chance a little of the ointment gets into the eye a very severe conjunctivitis often results. Upon the trunk and extremities a 5 or 10 per cent. ointment, made by rubbing up a finely sifted chrysarobin in vaselin, can be advantageously used; but upon the scalp and face the ointment of ammoniated mercury will generally prove efficacious, and is to be preferred to the chrysarobin. Schamberg is at present working on a substitute for this drug which does not present its drawbacks.

The writer recommends the following treatment: (1) **Alkaline bath**, removing scabs. (2) Ointment of **salicylic acid** gr. j (0.06 Gm.), green soap ʒij (8 Gm.), **chrysarobin** ʒij (8 Gm.), **ol. rusci** ʒj (4 Gm.), and **vaselin** ʒij (60 Gm.), applied with stencil brush to lesions below clavicle; above clavicle, **ammoniated mercury ointment**. Solution of **chrysophanic acid** in **chloroform**, applied with cotton, also valuable; upon evaporation of chloroform, cover with coating of **ichthyol**. (3) **Fowler's solution** internally. In stubborn cases, biweekly injections of **arsenic iodide**, 10 minims (0.6 c.c.) of 1 per cent. aqueous solution. (4) Diet, according to case. Cocks (Med. Record, Dec. 3, 1910).

The following preparation recommended for addition to **baths** given for removal of scales: **Oil of cade**, 50 Gm. (1½ ounces); black soap, 25 Gm. (6 drams); water, 50 Gm. Yolk of egg and a little fluidextract of **quillaja** may be added. Patient is to soak in bath and rub patches for ten or fifteen minutes. **Chrysarobin**, 2 Gm. (30 grains), or **pyrogallol**, 1 or 2 Gm. (15 to 30 grains), may also be used in the preparation. Patient is to apply **petrolatum** to patches in

daytime, then take bath and reapply petrolatum at night. Balzer, Godlewski, and Condat (Bull. de la Soc. Franc. de Dermat et de Syph., Feb., 1912).

Baths of pure warm water are decidedly beneficial to psoriasis. When the skin is in an erethic, irritable condition, sulphur baths, made by the addition of potassium sulphide, sometimes act badly, while **tar** and **potassium permanganate** are valuable additions. The blander salts, such as sodium bicarbonate, boric acid, and sodium chloride, probably decrease the effect of the bath, as their addition renders the water less osmotic. Montgomery (Jour. Amer. Med. Assoc., Oct. 26, 1912).

Measures employed with success by the writer in 11 cases of widespread psoriasis. After placing the patient in a **warm bath**, to which, if the skin is tender and irritated, **chamomile** or **bran** and **washing soda** are added, the skin is rubbed gently once or twice with **soft soap** and washed off, the scales removed and a washing then given with a 1:1000 solution of **mercury bichloride**. The skin is next well tarred with a preparation of coal-tar and **beech oils** in dilute **alcohol**, and the patient kept in the bath from twenty to thirty minutes longer. After this the **tar** is washed off and the affected parts are treated with the following paste:—

℞ *Sulphuris præcipitati*. 4 Gm. (1 dr.).
Acidi salicylici,
Zinci oxidi,
Amyliāā 1 Gm. (15 gr.).
Petrolati 25 Gm. (6¼ dr.).

M. et ft. pasta.

Sig.: Salicyl sulphur paste.

Talcum powder is then dusted thickly over the parts. Forty-eight hours later, the following ointment is used, followed by dusting with talcum powder:—

℞ *Pyrogallolis* 3 Gm. (45 gr.).
Adipis lanæ hy-
drosi 30 Gm. (1 oz.).

M. et ft. unguentum.

After another two days' pause a 25 per cent. ointment of **chrysarobin** in hydrated wool-fat is similarly applied. It may be necessary, by reason of the local irritation induced, not to use this ointment over all the affected parts at one time, but to cover them gradually.

In addition to the local treatment, two kinds of pills are prescribed, to be continued for some time:—

℞ *Phenolis* 10 Gm. (2½ dr.).
Extracti et pul-
veris glycyrr-
hizæ q. s.

Fiant pilulæ no. 100.

Sig.: Three to ten pills daily after meals.

And,

℞ *Arseni trioxidi* .. 0.5 Gm. (7½ gr.).
Pulveris piperis.. 6.0 Gm. (1½ dr.).
Acaciæ,
Altheæ,
Aquæ destillatæ āā q. s.

Fiant pilulæ no. 100.

Sig.: Three to ten pills daily after meals.

To these measures should be added plenty of **fresh air** and **rest**. The **diet** should be bland; the use of **meat** and **alcohol** should be **interdicted**, at least for a time. A. Bernheim (Monthly Cyclo. and Med. Bull., June, 1912).

Strong alcohol applied at night to the affected part by means of cotton compresses are very effective, according to Lau. The alcohol used varied from 70 to 90 per cent., and contained 2 per cent. of salicylic acid. A rubber dam or some other impervious material should be used to prevent evaporation, and the compress left until the following morning, when the parts are washed with soap and the loosened scales removed. The part is then anointed with lanolin. This method of treatment, besides being effective, is cleanly, and gives the patient no annoyance.

Pilocarpine has been found useful in some when administered hypodermically.

The writers gave **pilocarpine** in a case of psoriasis to see whether the increased perspiration induced would

relieve the troublesome itching. They found that the rash itself improved so much under this treatment that they regard it as curative as well as palliative. An intramuscular injection of 0.01 Gm. (¼ grain) of pilocarpine hydrochloride is followed in five minutes by violent perspiration and a flow of saliva. The injections were repeated at intervals of two to three days without general disturbances. After the sixth injection the rash almost completely disappears. K. Herxheimer and H. Köster (Berl. klin. Woch., Dec. 1, 1913).

The **X-rays** have been found of value, but only in chronic cases, and after preliminary curettage in the nodular form.

The X-rays should not be used in cases of the fresh eruption of psoriasis punctata, in which the disease is extending and involving new areas of the body; in this stage general **baths**, the application of **sulphur**, and the administration of **arsenic**, either internally or subcutaneously are indicated. Later, when new nodules no longer appear, and especially when dry, hard plaques are present which prove obstinate and always recur in the same place, the indication is for the **X-ray** treatment after a preliminary **curettage**. L. Freund (Wiener klin. Woch., Mar. 20, 1913).

Autoserum has been lauded by various authors, but others have not found it effectual unless used with local agents of known value. A suitable quantity of blood is drawn and centrifuged and the serum obtained injected intravenously.

Report of 6 cases of generalized psoriasis treated at the City Hospital, Blackwell's Island, with **autogenous serum**. The injections were given once a week—3 or 4 in number, of from 20 to 30 c.c. each, making about 100 c.c. in all—before the local treatment, of very mild character, was begun. The results were excellent. Gottheil (Med. Rec., Apr. 4, 1914).

Autogenous serum, when used alone, does not appear to be of value in the treatment of psoriasis. It is of decided value in many cases when

used in conjunction with **chrysarobin**. Obstinate cases of psoriasis, that have long resisted vigorous treatment with chrysarobin ointment, will often yield to this remedy when injections of autogenous serum are given. Intravenous injections of autogenous serum, if properly given, are entirely devoid of danger. The technique is comparatively simple. H. Fox (Jour. Amer. Med. Assoc., Dec. 19, 1914).

The writer used intravenous doses of 75 to 100 million **killed typhoid organisms** at intervals of three or four days in a number of very resistant cases of psoriasis. The first 1 or 2 doses reduced the inflammation in the lesions, diminished the scaling, and seemed to prevent the formation of new lesions. This was the extent of the improvement from this injection alone, but in 2 cases which had been receiving treatment by **chrysarobin** the lesions cleared up rapidly and completely. In others the addition of chrysarobin treatment was followed by prompt and complete recovery, although it had previously failed. F. J. Scully (Jour. Amer. Med. Assoc., Nov. 17, 1917).

The use of thyroid gland in psoriasis has not, on the whole, given satisfaction, although great improvement has been noted in certain cases. (See **Thyroid Gland** in the article on ANIMAL EXTRACTS, volume i.) As a rule, however, the doses used have been too large. Such doses so stimulate catabolism that they cause an accumulation of wastes in the blood, and thus favor the production of the disease. From 1 to 2 grains (0.065 to 0.13 Gm.) of desiccated thyroid three times daily should not be exceeded in these cases. S.

PSYCHOSES AND THE INTERNAL SECRETIONS.—While insanity has been defined as a departure from a normal standard of thinking and feeling, no mental conception or psychical manifestation can occur except through the medium of the brain. We are brought, therefore, to consider impaired nutrition

or structural changes in this organ as the underlying cause of mental disease.

A connection between the function of the ductless glands and diseases of the mind has long been thought to exist, the mental disturbances often witnessed in Addison's disease, myxedema, and exophthalmic having attracted attention in this direction. French clinicians, Sergent and Bernard, Boinet, Laiguel-Lavastine and others have studied these mental complications and have in fact erected syndromes of psychoses based on disordered functions of these organs. Yet the pathogenic relationship between the disorders of the ductless glands and mental disorders has remained obscure. So promising is the field, however, that I deemed it preferable to submit to our readers a review of the question as it appears to me most likely to aid them, rather than a mere outline of mental diseases obtainable in any textbook.

In tracing various mental disorders to their physiopathological source, with disorders of the ductless glands as features of the process, my own views of the functions of these organs will be taken as standards. This is rendered necessary by the fact, stated recently by Professor Halsted, of Johns Hopkins, that "there reigns the greatest confusion on the subject of the functions of the glands of internal secretion"—a state of things due to the lack of co-ordination of the vast and excellent work done in recent years on the subject. This defect has been avoided in my own labors because they have always been based on an orderly study of the various branches of biology bearing directly or indirectly upon the subject. This methodical and co-ordinated system could not lead me astray, and, as a result, the experimental work of the last twelve years has increasingly sustained my deductions. In fact,

they alone enable us to analyze with any degree of lucidity the functions or disorders with which the internal secretions are connected.

The space available will only permit a very brief summary of the evidence available in support of my interpretation of the rôle of the various ductless glands, their interaction, etc. The reader is referred for additional data to the sixth edition of my work on the Internal Secretions, and to my writings in general literature.

A feature which may simplify the present inquiry is that very few glands, from my viewpoint, produce an internal secretion in the sense that their product has a *specific* influence on the functions of all other organs as true hormones, *i.e.*, on the body at large. To endow with an internal secretion so many structures as is at present done undoubtedly serves greatly to obscure the whole problem and to hamper progress.

Again, while a few mental disorders are directly traceable to a single gland, the thyroid in cretinism for example, a clearer conception of the morbid processes actually present is obtainable when the relationship between the ductless glands that are actually known to produce internal secretions, are considered jointly as etiological factors. Not to be overlooked, however, in this connection, is the fact that in some instances there is loss of co-ordination between the glands, two or three, for example, being functionally deficient, while the rest are normal. The disturbed glands are then apt to indicate through various symptoms peculiar to them, or stigmata, the nature of the mental disturbance present. This makes it possible to meet abnormal conditions through organotherapy if deficient activity prevail, or to depress secretory stress if the glands are abnormally active.

These are but a few of the directions in which the internal secretions are related to psychoses. Other features of the question as a whole will be gradually developed, those introduced in the present article taking up mainly the practical sides of the subject.

FUNCTIONS OF THE DUCTLESS GLANDS IN THEIR RELA-

TIONS TO INSANITY.—Thyroid Gland.—The secretion of the thyroid gland is a compound in which iodine in organic combination is the active agent. It carries on two important correlated functions:—

1. It enhances oxidation by increasing the sensitiveness or inflammability of the phosphorus which all tissue-cells, particularly their nuclei, contain (including, of course, the cerebrospinal nervous system), to the action of the oxygen in the blood, its cellular elements, and the tissue-cells at large.

2. It takes part in the autodefensive functions of the body in conjunction with its glandules, the parathyroids, by increasing the sensitiveness (as opsonin) of what phosphorus bacteria, their toxins, endotoxins, toxic wastes, etc., may contain, to oxidation by the oxygen present in the blood, its cellular elements, and tissue-cells.

Summary of Evidence.—Concerning the influence of the thyroid on *metabolism*, thyroid preparations have often been shown to raise the temperature, sometimes several degrees; to increase the oxygen intake and the carbon-dioxide output sometimes over 20 per cent.; to augment nitrogen and phosphoric acid excretion, the latter sometimes very markedly. Graves's disease, we know, includes all these symptoms. Conversely, thyroidectomy lowers oxidation, the output of carbon dioxide, nitrogen, phosphoric acid,—all familiar symptoms of myxedema. The effects of thyroid gland in the latter disease and cretinism sufficiently emphasize the influence of the thyroid on general metabolism.

As to the *defensive rôle* of the thyro-parathyroid apparatus, its importance is no less great. Its secretion had been shown by several observers to possess both anti-toxic and bactericidal properties. The blood of thyroidectomized animals proved toxic—a condition relieved by the use of thyroid or thyroid grafts—while operated

animals were extremely liable to infection. On analysis, I was led to conclude, in 1903, that the thyroid took an active part *indirectly* in general immunity by increasing the functional activity of the adrenals, and, through these organs, general oxidation and metabolism; and, that the resulting increase of functional activity in those organs, which produced protective substances, correspondingly augmented in the blood the quantity of these substances—then known collectively as Buchner's alexins.

This view was confirmed experimentally at the Bacteriological Institute of Liège by Miss Louise Fassin, in 1907. I then offered chemical evidence to the effect that the thyroparathyroid secretion also acted *directly*, like Sir Almroth E. Wright's opsonins, *i.e.*, by sensitizing the pathogenic organisms, toxic wastes, etc., and thus preparing them for hydrolytic digestion. This also has been sustained by the investigations of Fassin, Stepanoff, and Marbé.

Concerning the *action on phosphorus*, it is explained through analysis of the manner in which this sensitization or "opsonization" is produced. All clinicians know that the use of thyroid preparations in young cretins is sometimes attended by softening of the bones and bending of the legs, notwithstanding marked general improvement. When it is recalled that five-sixths of the inorganic matter of bone consists of calcium phosphate, it becomes a question whether the thyroid does not influence cellular phosphorus. That such is the case is further suggested by the facts that iodine, the active constituent of the thyroid secretion, and its salts, cause excessive elimination of phosphates and phosphoric acid, and that thyroid preparations act in the same way. "Emphasis must be laid," writes Chittenden, "upon the apparent connection between the thyroid gland and phosphoric acid metabolism," giving as example "the increased excretion of P_2O_5 after feeding normal animals with thyroids, and the great decrease in the case of animals with the thyroids removed.

The untoward effects of large doses of thyroid preparations on the nervous system, owing to its wealth in phosphorus and fats, as manifested by tremor, tachy-

cardia, optic neuritis, etc., also bespeak such an action. Cyon, in fact, found that injections of iodothyrim excite the depressor nerve directly to such a degree that the vascular pressure often declined to two-thirds of the normal.

A familiar action of the thyroid preparations is a rapid reduction of fat in obese subjects, when full doses are administered. The presence in the fat-cell of a nucleus rich in phosphorus, whose purpose is promptly to promote oxidation of the fat when the organism requires additional carbohydrates, explains this action. Schöndorff, in fact, found that the reserve fats could be exhausted before the nitrogenous tissues were affected.

The mode of action of the thyroid active principle, iodine, is suggested by the presence of this halogen in all nuclei, as shown by Justus and others. This means that iodine is found wherever phosphorus is present, while, as shown above, it is most active where phosphorus is known to be most plentiful. Now, chemistry furnishes a clue to the manner in which all the phenomena I have enumerated are produced. "If a fragment of phosphorus, lying on a plate, is sprinkled with iodine," writes Wilson, "the substances unite, and heat enough is produced to kindle the phosphorus." Nitrogen, hydrogen, and chlorine are ubiquitous constituents of our tissues, and the vigorous explosives they form with phosphorus and the intense liberation of heat the reactions entail are familiar features of the laboratory. Roos found that, in a dog in nitrogenous equilibrium, iodothyrim "caused at once a marked increase in the output of sodium, sodium chloride, and phosphoric oxide."

The Thyroparathyroid Apparatus in Insanity.—*Graves's disease*, as is well known, frequently includes mental disorders. Here, from my viewpoint, the underlying cause is a toxemia due to the accumulation in the blood of catabolic wastes resulting from the excessive activity of the thyroid. In addition to this, there is general vasodilatation, or general relaxation of the arteries owing to the

excessive catabolism to which the vascular muscles are subjected by the excess of thyroid secretion poured into the blood. The poisons and general vasodilatation, by affecting the brain, brings on the morbid phenomena. Besides the usual symptoms of the Graves's disease present there may occur:—

A type of *melancholia* in which ideas of persecution, great anxiety concerning the health or shape of the body, marked restlessness, leading up in some cases to great irritability may also lead finally to

An *acute mania* in which the vasomotor phenomena predominate, the face being flushed, the skin, throat, and tongue dry, and the usual throbbing of the arteries witnessed in the disease being extremely marked. Dermographia is very prominent, the line left by the instrument or nail on the skin remaining visible nearly one minute. There is great restlessness at first, then excitability, jactitation, the patient being noisy with some tendency to violence, the pulse being high (140 to 150), and the temperature somewhat above normal. In such cases the brain and its membranes were found to be the seat of congestion (Savage, Schenck, and others).

Conversely, *myxedema*, besides the familiar form of idiocy it induces in children, *i.e.*, cretinism, gives rise to mental disorders in nearly one-half of the cases according to the English Myxedema Committee after an extensive investigation. The types most frequently observed were *melancholia* with delusions and hallucinations, and due to lower metabolism occurring as a result of the deficient thyroid activity, *acute* or *chronic mania*, and *dementia* due, from my viewpoint, to the accumu-

lation in the tissues, including the brain, of intermediate products of metabolism which a normal supply of thyroid secretion would, in conjunction with other internal secretions, have converted into eliminable products. The stigmata of myxedema may also be discerned, if carefully sought, in other forms of insanity. Thus, Bernstein (Russki Archiv, Dec. 31, 1899) found them in practically all cases of *dementia precox*.

Briefly, two factors may prevail in insanities of thyroid origin. Excessive activity of the gland as in *Graves's disease* may precipitate into the blood a greater volume of products of catabolism (phosphoric acid, etc.) than the body can eliminate; while deficient activity of the thyroid, by failing to break down normal products of catabolism, food wastes, etc., may give rise to a toxemia which disturbs the organ of mind, besides disturbing its circulation.

THYMUS.—The thymus gland supplies to the tissues at large, and through the agency of lymphocytes, the excess of nucleins which the body, particularly the osseous, nervous, and genital systems, requires during its development and growth, *i.e.*, during infancy, childhood, and adolescence, or later if need be, to construct the nuclei of its cells.

Summary of Evidence.—As is well known, the thymus is supposed to have disappeared, or to have undergone fatty degeneration at about puberty. This, however, is not always the case, a persistent thymus being found not only in conjunction with other disorders, but also where development has not been completed or is defective, as in Mongolian idiocy. In fact, careful histological examination shows that some of the parenchyma of the thymus endures until old age. Removal of the thymus does not directly compro-

mise life, but it impairs strikingly the development of the *osseous system*; a rickets-like condition results; the bones become soft and pliable, sufficiently so in some instances to result in genu varum; they are more readily fractured, owing to slow calcification. This is due to a reduction of the calcium in bones and other tissues (Bracci, 1905), a fact accounted for by the high excretion of this element in thymectomized animals (Basch), and sustained by the observation of Soli that thymectomized hens lay eggs without shells. The influence of the thymus on the osseous system is further shown by the fact that the implantation of thymus into thymectomized animals causes a resumption of growth, especially marked in the long bones (Sommer and Floecken, 1908). The nature of these morbid effects and of the rôle of calcium in the process point clearly to the identity of the underlying cause, viz., a defective formation of calcium phosphate.

Whence comes, however, the phosphorus required in the process? This recalls another feature of thymic chemistry; the wealth of the thymus in nucleinates, its lymphoid cells, according to Chittenden, containing a nucleoproteid rich in phosphorus—3.5 per cent. It becomes a question, however, whether this phosphorus enters at all into the physiological functions of the organ. That such is the case is shown in various ways. Moreover, removal of the thymus in dogs is followed by clear evidences of idiocy (Morel, 1914).

Yet the bones and central nervous system are not the only structures morbidly influenced. Ruhräh has reported 18 cases of infantile marasmus, in which the thymus alone showed lesions. Notable atrophy of the organ was also found in 20 cases of marasmus in infants, under 1 year old, by R. L. Thompson. Dudgeon was led to conclude that atrophy of the thymus was the most characteristic feature of marasmus. Rohrer, Bovaird, Nicholl, Warthin, Rachford, and others have defended the same view. This, however, is but a result of defective nutrition due to artificial feeding and is avoided and cured by breast feeding. Friedlieben, as far back as 1858, found that "the size and condition of the thymus is an index to the state of nutrition of the body. It emphasizes the im-

portance of good food to sustain the functional activity of the organ *during infancy while the organ of mind is being developed* in keeping with the rest of the body.

The influence of the nucleins, or at least of the phosphorus in the nucleinates, which the lymph-cells of the thymus contain is thus not exercised over a particular tissue, but over all tissues.

How is the phosphorus transmitted from the thymus to the tissues? This question finds an answer in the relationship between persistent thymus and Graves's disease. In 133 cases of the latter disease, in which death had followed operation, Mattis found, for instance, that 76.5 per cent. had an abnormally large thymus. The labors of Klose, Capelle, and others have also demonstrated that a persistent thymus could produce Graves's disease, that thymectomy, first found efficient by Garrè, is regarded as a warranted procedure. Now, this operation confirms what experimental medicine had demonstrated, viz., that thymectomy caused a gradual decrease in the leucocyte count, while the administration of thymus caused an increase of these cells. In Graves's disease, due to persistent thymus, the operation not only reduces the tachycardia, but also a typical symptom to which Kocher called attention, lymphocytosis. In Garrè's case, removal of the thymus brought the lymphocytosis down from 40 to 10 per cent.; other surgeons, including Halsted (1914), have observed the same phenomenon. This shows plainly that the thymus is the source of the excess of lymphocytes in the blood—a fact which in itself points to the mode of distribution of the nucleins, or phosphorus in organic combination, since we have seen that thymic cells are rich in nucleinates.

The Thymus and Insanity.—In its influence upon insanity, the thymus takes a leading place. In *idiocy* there is marked evidence, in the light of the above data, that this organ is deficient. The indications of defective bone development are numerous in the symptomatology of the disease. Even the rickets following experimental thymectomy is reproduced in some cases,—the

result we have seen of defective formation of calcium phosphate which the phosphorus-laden nucleins supplied by the thymus insures.

The idiocy produced in animals by the same experimental procedure corresponds precisely with the teachings of pathology. Thus, at the request of Bourneville, Katz performed autopsies in 61 mentally normal children, who had died of various diseases, varying in age from 1 month to 13 years; in all of these the thymus was present. In 28 mentally weak children examined *post mortem* by Bourneville, however, the thymus was absent. In another series of 292 cases of mentally deficient children, the organ was absent in 74 per cent. At Bicêtre, from 1890 to 1903, autopsies of 408 non-myxedematous idiots ranging in age mostly from 1 to 5 years—none being above 15 years—showed the thymus to be present in only 104 instances (Morel, 1914). Lange and Dicker, Garrè and Lampé have reported cases of idiocy in which at autopsy the thyroid was found quite normal, while the thymus was very small. That phosphorus is a fundamental constituent of cerebral tissue need hardly be emphasized.

Dementia precox also shows in many ways some connection with the thymus. There is a marked reduction of the lymphocytes in this disease which the therapeutic use of thymus gland corrects. Deficiency of nucleins is also shown by the excess of purin bases in this disease. Defective metabolism of the bones is shown by the frequent presence of osseous disorders such as osteomalacia and fragilitas ossium. Therapeutically, Ludlum and Corson-White (Am. Jour. of Insanity, April, 1915) obtained excellent results in 3 out of 6 cases of dementia precox. the 3 pa-

tients in whom it failed being old and much demented.

Adrenals.—The secretion of the adrenals, on reaching the heart by way of the inferior vena cava, assists the contractile activity of the right ventricle. On reaching the air-cells it absorbs oxygen from the air and is then taken up by the red corpuscles, becoming therein the albuminous constituent (adrenoxidase) of their hemoglobin. This adrenoxidase is carried to all tissues by the red corpuscles, to supply the tissue-cells the oxygen needed to carry on oxidation in all metabolic processes.

Summary of Evidence.—The process through which the body is supplied with oxygen is still obscure. The absorption of oxygen by the pulmonary blood persists even when the pressure of this gas is almost *nil*. A strangulated animal exhausts the air in its lungs of *all* its oxygen, while only traces of oxygen are to be found in the arterial blood of asphyxiated animals. These facts have long emphasized the belief that the diffusion doctrine was defective, and that the absorption of oxygen from the air was due to the presence, in the blood circulating through the lungs, of some substance capable of taking up this gas. This conclusion was sustained by the researches of Bohr and others, Bohr and Henriques concluding that the substance "having greater avidity for oxygen than the blood itself" in the lungs was presumably "a kind of internal secretion."

The advocates of the diffusion theory (whose aërotonometric figures are suggestively discordant) have opposed this view, but, as stated by Pembrey, "the body of evidence has been steadily increasing in favor of the secretory theory, especially as regards the absorption of oxygen."

Adrenal extractives being endowed, as is well known, with marked reducing properties, it appeared to me eminently fitted to act as the "internal secretion" sought by Bohr. Anatomical studies in lower animals and in man, and a systematic research in the literature of the subject, showed that this assumption was sustained by a large number of experimental and clinical

facts, the principal of which were as follows:—

1. The secretion of the adrenals, while possessing a marked affinity for oxygen, inevitably reaches the pulmonary air-cells. The blood of the efferent vessels of the adrenals, their veins, passes to the inferior vena cava, directly on the right side, and by way of the renal vein on the left. The actual presence of the adrenal secretion in the blood of the adrenal veins is shown by many experimental facts. Hyaline granules (found subsequently to be their secretion) passed from the interior of the adrenals to their veins. The same granules were traced from the interior of the organ along the adrenal veins to the vena cava itself. It is doubtless the adrenal secretion, and no other, which is carried by the blood of the vena cava; for, when blood originating from the adrenals on its way to this great trunk was injected into animals, it produced the characteristic effects of adrenal extract, while such effects could not be obtained with venous blood obtained from other parts of the body. In the lungs the adrenal principle dilates the bronchioles, obviously to aid respiration and to increase the air intake.

2. On reaching the air-cells, the adrenal secretion absorbs oxygen, and becomes a constituent of hemoglobin and of the red corpuscles.

Gamgee states that "hemoglobin exists in the blood-corpuscles in the form of a compound with a yet *unknown constituent* of the corpuscles." This body he defines as the "albuminous moiety of the hemoglobin molecule" and as representing 96 per cent. of this molecule, the remaining 4 per cent. being the iron-laden hematin. Now this "unknown constituent" of hemoglobin corresponds in its physicochemical properties with the adrenal secretion.

Again, adrenal extracts are rapidly destroyed by alkalies; this is also a characteristic of hemoglobin. This pigment likewise resists heat up to the boiling point; this applies also to adrenal extract. Moreover, Mulon found that the red corpuscles gave the histochemical reactions of the active principles of the adrenals, thus showing that these blood-cells actually contain this principle. Bröking and Trendelenburg found adrenalin in normal blood

in the proportion of about 1 to 2,500,000, and that this proportion was doubled and sometimes quadrupled in true exophthalmic goiter. J. L. Miller found it increased four or five times in simple goiter. Batelli isolated from the blood a product endowed with the chemical properties of adrenalin. This adrenal principle is, doubtless, present in the albuminous portion of hemoglobin voided by red corpuscles into the plasma; for the latter contains an oxidizing substance or oxidase (the adrenal ferment dealing out the oxygen it took up in the lungs) which resists heat to the boiling point, and possesses other chemical characteristics of the adrenal principle. Again, while in 1853 Traube had concluded that hemoglobin could not fulfill the physicochemical functions ascribed to it without the aid of a catalyzer, Poehl showed that the adrenal principle was a catalyzer, and Jolles found that the activity of a given volume of blood as a catalyzer corresponded with a number of red corpuscles it contained.

3. The red corpuscles, after absorbing the oxygenized adrenal secretion (the albuminous constituent of their hemoglobin), yield it to the blood-plasma in the form of droplets.

Louis Elsberg, many years ago, observed "a projection of a pediculated granule or knob" from the periphery of red corpuscles. Hirschfeld traced these granules from the interior of these cells through one or more minute apertures, which closed up again, to the surrounding plasma. Brockbank gave recently a beautiful microphotograph of "platelets in or being extruded from red cells." Again, Detemann noted that the buds on the surface of the red cells "at first are attached to the cell by protoplasmic processes and contain hemoglobin"; but that "later, the buds become separated from the cell, losing their hemoglobin." The coloring matter remains in the corpuscles, the albuminous constituent being alone voided into the plasma.

Biedl states that "the entire question of pigmentation in Addison's disease is urgently in need of further investigation." The following data have seemed to me to indicate that:—

4. The albuminous constituent of the

hemoglobin, or oxygen-laden adrenal secretion, is distributed by the red corpuscles to all parts of the body as an oxidizing agent.

Most classic writers consider melanins, the brown and black pigments found, in certain forms of sarcoma, in the tissues, the blood, the urine, etc., in various morbid states, as hemoglobin derivatives. While Mörner, Brandl, and L. Pfeiffer found that it contained iron, and accept this origin, Nencki and Berdez do not, because they failed to find this metal in the pigment isolated from a melanotic sarcoma. These discordant opinions are harmonized, however, by the newer conception I submit. The first-named authors dealt with whole hemoglobin, containing, therefore, its iron; while Nencki and Berdez dealt quite as surely with hemoglobin, but only with its albuminous constituent.

Having traced to the adrenals the origin of the active agent of this albuminous hemoglobin, and this substance being melanin, the presence of the adrenal principle in melanins must be shown. In the first place, these pigments were found by Walter Jones insoluble in alcohol, ether, benzol, chloroform, etc., *i.e.*, precisely as is the case with the adrenal principle. This applies as well to the action of alkalis, to which Jones, Abel, and Davis found melanins very sensitive, and to other tests. In the second place, direct evidence was afforded by Boinet, who found, chemically, that the bronze pigment of Addison's disease was identical to melanin, and also by Mühlmann, who discovered independently that the Addisonian pigment was a product of the adrenals. Its deposition as bronze pigment is due, from my viewpoint, to regional slowing of the capillary circulation.

A connection between the adrenal product and respiration and oxygenation is further sustained by the fact that (5) an excess of adrenal secretion causes a rise of temperature. This action was first observed by Oliver and Schäfer. Reichert recorded a rise of 1° C. in rabbits, accompanied by increased metabolism. Morel noted a rise of 0.5° to 1° C. (0.9° to 1.8° F.) in guinea-pigs. Lépine states that the increase of blood-pressure caused by adrenal extract is always followed by a

rise of temperature. This is controlled by the familiar fact, first observed by Brown-Séquard, that removal of the adrenals is followed by a steady decline of temperature, and also by the hypothermia which attends Addison's disease. Finally, Fuchs and Roth found that subcutaneous injections of adrenalin (1.0 to 1.5 mg.) caused the respiratory rate to rise, while increasing the intake of oxygen and the output of carbon dioxide. This was confirmed by Bernstein and Falta.

As previously inferred, this is but a part of the evidence on this particular feature of the general problem. I studied, for example, the evolution of the red corpuscles throughout the animal scale, and learned that they were tardy additions to the blood as storage cells, when the hemoglobin diffused in the plasma, as it is in many invertebrates and in certain low vertebrates, failed to satisfy the needs of the vital process. Having been brought to the conclusion that, contrary to what is now taught, it is the plasmic adrenoxidase or hemoglobin which carries oxygen to the tissues and not the red cells, I traced this substance in various tissues and organs, including the nervous system (1903), the guaiacum and methylene-blue tests being those most frequently employed. The oxidases having given the reactions of the oxygen-laden adrenal secretion, I applied to the latter the term *adrenoxidase*.

The Adrenals in Insanity.—Addison's disease exemplifies clearly the influence of adrenal insufficiency, which means from my viewpoint deficient oxidation in the brain-cells as well as elsewhere in the body. Hence the *psychic asthenia*, the somnolence, the apathy, and the almost absolute loss of will-power—*abulia*. A mild form of *melancholia* is sometimes suggested by these cases.

There is, however, a true *acute mania* observed occasionally in Addison's disease. This has been attributed by Chauffard, Sergent and Bernard, Laiguel Lavastine, and others to "Addisonian intoxication," but from my

viewpoint we are dealing also with a passive hyperemia of the brain due to relaxation of the arterioles which regulate the blood supplied to this organ. The tone of these arterioles, as is well known, is sustained by the adrenal secretion, and when, as in Addison's disease, its supply is deficient, the arterioles relax, allowing an abnormal volume of toxic blood (toxic because the antitoxic process in which the adrenals take part is defective and toxic waste products accumulate in the blood) to penetrate the brain. The patient then abandons his passive apathy and becomes cross, sleepless, impatient, and fault-finding. Then delirium sets in with shouts, incoherence, hallucinations, and violent excitement, the patient sometimes running about nude and resisting his attendants. After two or three hours, muscular spasms appear which lead up sometimes to true convulsions, with oscillations of the head and a tendency to asphyxia, which may prove fatal. Exhaustion may also carry off such cases when, after the convulsions, they pass into a comatose state. In a case of this sort reported by Boinet, the attack resembled closely one of delirium, although the patient had not used alcohol.

Irrespective of Addison's disease, *periodical acute mania* is not infrequently observed which resembles the above type. The attack here may be initiated by a mild form of *melancholia*. Then more or less suddenly there occurs excitement, restlessness, twitching of the limbs, incoherent chattering, hallucinations, insomnia, dirty habits, etc. In some stupor follows. In others the attacks are quite as severe as in those due to Addison's disease and follow much the same course.

The *paranoid form of dementia precox* is sometimes attended with intercurrent attacks of acute mania similar to that just described.

All these are greatly benefited and in some instances cured by means of **adrenal gland** provided it is given in sufficient doses and persisted in. It is a mistake to believe that it is inert thus administered: 10 grains (0.66 Gm.) thrice daily of the desiccated gland soon begin to show good effects in appropriate cases. W. Schmidt (Münch. med. Woch., Feb. 17, 1914) found that cases of dementia precox failed to show a rise of blood-pressure under injections of adrenalin, whereas normal individuals showed such a rise. This is because the deficiency of secretion due to the inadequate activity of the adrenals has to be made up before the blood-pressure is noticeably affected by the drug. **Thyroid gland** is a valuable adjuvant when the blood-pressure is high, and when there is stupor, the high vascular tension being due to toxic wastes which, the adrenal and thyroid gland given, help to convert into eliminable products, as participants in the defensive functions of the body.

GENITAL GLANDS, PITUITARY AND OTHER DUCTLESS GLANDS.—Limitation to the glands just reviewed is imposed by the fact that several organs which are generally believed to produce an internal secretion have not been definitely shown to do so. These are the pituitary body, the pineal, and the kidneys.

We are not really justified, therefore, in drawing conclusions as to their mode of action in insanity. An outline of the action of these glands, as I understand it, may, however, prove suggestive:—

As to the *testes and ovaries*, they do not, from my viewpoint, produce an internal secretion possessed of a specific action throughout the body, but one intended only to influence those structures which form part of the mechanism to which the secreting organ belongs—the ovary, for instance—in its relations to the genital apparatus. This class might be termed *autonomous* internal secretions, to identify them from those which affect the body at large, the true hormones, as defined by Starling, who wrote recently: “By the term ‘hormone’ I understand any substance normally produced in the cells of some part of the body, and carried by the blood-stream to distant parts, which it affects for the good of the organism as a whole. The hormones are thus the chemical means of correlation of the activities of different parts of the body.”

This does not mean that preparations of these glands in organotherapy may not serve useful purposes or even have an action quite specific to the organ employed; but I hold that this does not necessarily indicate that the effects witnessed are those of an internal secretion, or proves in the least that such a secretion is actually produced by the organ. In the case of the testicles and ovaries, the autonomous secretion of these structures undoubtedly affects the system at large; but apart from the structures which belong to the genital system (including the mammary gland), the products which reach outside organs are materials which have not been used (the semen and its spermatozoa, for instance) for purposes of procreation. What these unused secretions contain—spermin, nucleins, etc.—is, therefore, added to the general supply; hence, among other phenomena, the debility caused by excessive venery, masturbation, etc.; hence, also, the obesity of operative menopause, the organism at large having lost a source of stimuli which give (this applies also to pituitary extracts) the chemical reactions of the adrenal active principle, modified slightly as to physiological effects through its organic combination with cell nucleins. Indeed, the posterior pituitary, for instance, gives the chromaffin which denotes the presence of the adrenal principle.

Pancreas.—This organ supplies an internal secretion which is distributed to the organism at large by leucocytes. It governs carbohydrate metabolism and takes a direct part in the protein metabolism of tissue-cells, and also in the defensive reactions in these cells, and in the blood-stream. Its internal secretions also contains a trypsin-like ferment, which is an active agent in the catabolic phase of metabolism, and in the destruction through its digestive property of bacteria, their toxins, toxic wastes, and other pathogenic proteins.

The pancreas, first shown by R. Lépine to be the source of an internal secretion which he termed “glycolytic ferment,” is important in the present connection in that, as first suggested by myself and sustained by the investigations of Abderhalden, it takes part in defensive processes of the tissues, including the blood. So far, its direct connection with insanity has not been studied, and it is mentioned because its functions, from my viewpoint, are interwoven with those of the organs reviewed in the manner described under the following heading:—

Co-operative Functions of the Ductless Gland.—Normally all the foregoing ductless glands functionate harmoniously. From my viewpoint, their co-operative functions—which apply also to the brain—are as follows:—

The *thymus* supplies to all tissues the excess of phosphorus in organic combination (nucleins) required during the development of the body, to build up its cell nucleins. The *thyro-parathyroid apparatus* supplies a secretion (thyroidase), which sensitizes all these nucleins to the action of oxygen. The *adrenals* supply a secretion which (through its katalytic ferment adrenoxidase) endows the blood, including that supplied to the neurons of the brain, with its oxygenizing properties. The *pancreas* supplies the ferments which, in the intestinal

canal and nutritional leucocytes, convert food materials into products harmonious to, and for the building up of, tissue-cells, *i.e.*, for the anabolic phase of metabolism; the same pancreatic ferments carry on the katabolic phase of metabolism.

All endogenous or exogenous substances which are not appropriate for tissue building—bacteria, toxins; toxic wastes, toxics, venoms, etc.—are subjected in the phagocytic leucocytes, the tissue-cells, the lymphatic system, and the blood-plasma, to the katabolic phase of metabolism, which serves to convert them into eliminable end-products.

The defensive mechanism of the body thus forms part of its nutritional processes, the whole being dominated, as far as present knowledge enables us to judge, by the internal secretions reviewed.

Co-operative Ductless Glands in Insanity.—While each of the ductless glands reviewed impresses its own characteristics upon the mental disorders it causes, when its functions are seriously disturbed, these characteristics are lost when all jointly become functionally weakened or overactive. Insufficiency of the glands entails diminution of metabolic activity. To this class belongs those psychoses usually ascribed to disturbances of nutrition characterized by melancholia, *i.e.*, the depressive insanities. They are not, however, ascribable only to deficient metabolism and its defective nutrition, but also to the fact that this condition of the ductless gland entails also inadequate destruction of organic poisons. Hence the fact that, from my viewpoint at least, *melancholia denotes deficient metabolism plus a toxemia*, a condition which, when it reaches a certain limit, is attended with vascular relaxation and cerebral hyperemia. When this stage is reached we have *toxemia and cerebral hyperemia of the brain with delirium or mania* as result. This explains why melancholia often precedes maniacal phenomena.

MENTAL DISEASES.

[Dr. Frederick Peterson (Textbook on "Nervous and Mental Diseases," p. 659, 1908) wrote a few years ago referring to prevailing classifications: "To any but the expert and special student some of these classifications must, indeed, be mystifying and incomprehensible. They are forbidding to the ordinary student and to the general practitioner, and might well induce him to shun the realms of psychiatry which open before him so uninvitingly and present such obstacles to his progress." It is precisely because of this that in preceding editions, the present department was placed at the disposal of an essentially practical psychiatrist, the regretted Dr. George H. Rohé, of Baltimore. So faithfully did he carry out the wishes of the editor, that his article is known to have rendered material service to those of our readers who are general practitioners. It was deemed wise, therefore, to perpetuate and to adopt both his classification and his interpretation of the various disorders described, excepting those belonging strictly to the field of the ductless glands. Each disease will then be analyzed by itself in respect to its relationship with the latter organs, and the newer methods of treatment it suggests. To distinguish the text preserved from Dr. Rohé's article and give him due credit his initial R. will appear at the end of each section written by him, while the remarks introduced by the writer will be signed: S.]

CLASSIFICATION.—The first requisite for a logical study of insanity is a rational classification,—one based upon the known pathology or pathogeny of the disease.

In such a classification there are seven classes or groups of mental disturbance, most of them clearly differentiated clinically. The groups are as follows:—

I. Psychoses due to imperfect development of the brain.

II. Psychoses due to vicious or abnormal brain-organization.

III. Psychoses due to simple disturbance of nutrition in the brain.

IV. Psychoses due to microscopic structural alterations in the brain.

V. Psychoses due to gross lesions of the brain.

VI. Psychoses due to toxic substances circulating in the brain.

VII. Psychoses due to developmental changes in the brain. R.

GROUP I. PSYCHOSES DUE TO IMPERFECT DEVELOPMENT OF THE BRAIN.

MYXEDEMATOUS IDIOCY OR CRETINISM.—Myxedematous idiocy is a psychosis due to deficiency or imperfect development of the brain, caused primarily by deficient activity of the thyroid gland and also as a result of this, by deficient activity of the other ductless glands.

Symptoms.—These consist mainly in more or less idiocy, stunted growth, and the cretinic facies. Early in the history of the case there is, as a rule, enlargement of the tongue and lips, myxedematous swelling, which seldom appears before the first year (a fat baby being, in some instances, a myxedematous baby), arrest of growth, delay in learning to speak and walk, dryness and scaliness of the skin, coarseness of the hair, a squatty or "saddle" nose, scantiness of the eyebrows, puffiness of the lids, and a prominent abdomen or "pot belly." In severe cases, the child reminds one of an aged person, being wrinkled and yellowish; the "fat baby" variety belongs to the larval form of the disease due to slight insufficiency of the thyroid. The thyroid is enlarged in severe cases, but not always in the hypothyroid type, in which it may be hardly discernible. The teeth, which may be represented by but a few sharp points, are irregular and tend to decay early.

Backwardness in learning to walk and talk, the enlarged tongue which interferes with respiration when the child is in the recumbent position, thick pads in the supracapsular region, are the most reliable diagnostic signs of the disease.

The mental state of the child depends upon the severity of the case. In some it is not far removed from that of the "human plant" as Roesch described such a case. The child fails to recognize its parents or any other person from an object, even toys. It neither weeps nor laughs. It is absolutely apathetic, sits quietly without manifesting any special wants. It may, however, show signs of hunger or thirst, either by crying like an infant or by grunting. In the higher grades, a few words may be spoken; there is recognition of the parents and familiar faces, and some sign of affection shown for them, but beyond a very limited vocabulary no progress is made. Still higher grades of cretins may speak fairly well, be free in their movements, but fail to develop thereafter.

While *thyroid stigmata* should predominate in view of the classic conception of the disease, the actual condition is one which entails secondary involvement of the other ductless glands, owing to the deficiency of the iodine in organic combination (thyroidin) supplied by the thyroid to sensitize the phosphorus or nucleins of all tissues, including the cerebral cells. Clinical experience has shown that as soon as it is supplied by administering thyroid gland, the functions of the body are resumed, unless it is administered after irremediable organic changes have occurred. When we speak of "thyroid stigmata," therefore, we understand the effects

that the absence of sufficient thyroid secretion awakens by passively inhibiting the functions of the other ductless glands.

Viewed in this light the *adrenal stigmata* are secondary, but clear. Defective oxidation is well shown by the subnormal temperature, the cold surface, the marked diminution of nitrogen excretion, and the low pressure, the heart and blood-vessels losing their tone.

As a result of general vasodilation and low tension the peripheral circulation is deficient and pallor ensues, the myxedema being in part due to tissue infiltration by blood-serum. All muscular elements being likewise deprived of blood, and what blood is received being poor in oxidizing principle (adrenoxidase), the muscles in general are ill-nourished and flabby; a similar condition of the intestines practically prevents peristalsis with inveterate constipation as result, occasionally outbursts of diarrhea relieving the situation.

The *thymus stigmata* are revealed through the defective development of the osseous system, the saddleback nasal bones, the stunted growth, the tardy closure of the fontanel, the lordosis and the distortions of the limbs. The hands are broad, spade-like, and the fingers pudgy and stiff, a condition reproduced in the feet, the toes of which are more or less kept apart by the thickened myxedematous skin.

On the whole, myxedematous idiocy is due essentially to inhibition of the ductless glands with the thyroid as starting point.

Etiology.—It is necessary in this connection to recognize two types. The first of these, *endemic* cretinism, is often a family disease, and observed in groups in certain localities. It is be-

lieved to be due to some chemical substance or micro-organism peculiar to the waters available in those regions. *Sporadic* cretinism, also termed "cretinoid," occurs in any country or region, and in families otherwise healthy. It is mainly due to some lesion of the thyroid caused by an acute febrile disease or some intoxication capable of inhibiting or arresting its functions either before or after birth. From my viewpoint, these factors cause the disorder by initiating organic lesions in the glandular tissues through hemorrhages, autolysis, etc. These areas leading to the formation of fibrous tissue areas, cirrhotic atrophy occurs sooner or later, limiting correspondingly the functions of the organ.

Treatment.—The treatment has been described at length in the first volume, page 717, in the section on ANIMAL EXTRACTS. The reader is referred to that department. S.

MONGOLIAN IDIOCY.—The characteristic feature in this form is that implied by its name: the resemblance of the patient to a Mongolian, including the slanting eyes, the flat nose, etc. The patient is small, the tongue is usually thick and heavy, and the hands short and square. He is more or less mentally dwarfed, but is usually amiable, well behaved, and affectionate; showing, as a rule, a marked predilection for mimicry and music.

An important feature of these cases is the early appearance of the Mongolian features, which are sometimes recognizable at birth, thus affording the earliest opportunity for treatment. The Mongolian infant is usually well behaved, so good, in fact, as to elicit comment and favorable comparison with the average lusty baby. Small at birth, it

develops about one-half as rapidly as the normal child, but its emotions are still slower in developing, in keeping with its powers of observation, which are virtually *nil* during the first year. It will lie in bed placidly hours at a time, apparently quite contented.

The *thymus stigmata* are evident in these cases. Defective bone development is well marked: the low average stature due to shortness of the long bones; the stubby, square hand, and the squatty nose. The skull likewise shows participation in the morbid process, the anteroposterior diameter being almost equal to the transverse, a fact which causes the head to appear round. The circumferential measurements are invariably below normal, sometimes two and one-half inches, the average being, in 26 cases studied by Muir, one and one-third inches. Additional evidence as to defective bone nutrition is shown by the frequency of rickets, sometimes discernible at birth. This applies also to defects such as club-foot, dislocation of the hips, palatal deformities, etc. The teeth, surrounded by hypertrophied gums, are irregular and undergo caries early. They appear late, the second dentition being also delayed.

The *thyroid stigmata* are few. While the skin is smooth in some, in others it is dry and rough, as in cretinism. The hair is usually soft and straight, but occasionally it is coarse. As in the cretin also, the tongue is thick and heavy, but it presents, in the Mongolian idiot, characteristic transverse fissures and greatly hypertrophied papillæ, the organ being thus rendered very rough. Subnormal temperature with marked sensitiveness to cold and sluggish circulation are also commonly noted.

The *adrenal stigmata* are mainly mus-

cular. The development of the entire musculature is considerably delayed, muscular power likewise. The ligaments are so loosely strung, in fact, as to permit the freest movements and contortions; the fingers, for example, may be bent backward upon the dorsum of the hand with the utmost ease. And yet all muscular movements are clumsy, being poorly co-ordinated, a feature which, in affecting the lingual musculature, contributes considerably to the retardation of speech. The ocular muscles are likewise involved, as shown by the frequency of strabismus and nystagmus in these patients. This applies also to the abdominal muscles, hernia, especially the umbilical form, being common. The abdomen itself is usually large and distended owing to relaxation of its musculature.

There is no evidence pointing to the participation of other ductless glands—the pituitary, ovaries, testes, pineal, etc., though the pancreas, which, as we have seen, is looming as a predominant entity in the cellular vital process, may participate in the process. Yet no evidence revealed so far warrants its introduction into the pathogenesis of the disease. We are, therefore, left, in so far as stigmata are concerned, with the hypothyroidism, hypothyroidism, and hypoadrenalism as the etiological tripod of Mongolian idiocy, with the thymus predominating.

This enables us to understand phases of the disease which do not come under the head of “stigmata.” We have seen that the nucleins supplied by the thymus and the secretions of the thyroid and adrenals took jointly an active part in tissue metabolism and immunity. Inadequate activity of these organs lowers the development and functional activity of the osseous, muscular, and

nervous systems; it should, therefore, also lower the defensive efficiency of the organism. That such is the case is shown in various ways. The Mongolian idiot is peculiarly subject to bacterial infections of the tissues most exposed to them, the respiratory and intestinal tracts, the eyes, skin, etc. He is an easy prey, therefore, to tuberculosis, bronchopneumonia, pneumonia, influenza, and bacterial diseases of the intestinal canal, succumbing promptly under their effects. The twenty-fifth year is reached in but 9.4 per cent. according to Wiggandt.

Deficient metabolism, initiated during uterine life, accounts also for the idiocy. Along with the rest of the body, the intelligence lags behind, owing to deficient development of the organ of mind.

Etiology and Pathogenesis.—Many of these cases occur as offspring of couples that have been prolific, the little Mongolian being the last brother or sister of many normal children. Leeper, for example, in a study of 176 cases of Mongolian idiots, found that one-half of these subjects were the last born of large families, and that neuroses were common in their ancestral histories. Again, they will occur as the product of aged couples or where there is a marked disparity in ages. Alcoholism, syphilis, gout, a violent emotion and neuroses in the near or remote parentage are also incriminated. Injuries to the head during birth have been considered as a possible cause, but not on positive grounds.

A feature of these little patients is that they look alike to such a degree in all countries, that they might be taken for closely related members of a single family. From my viewpoint, the peculiar Mongolian facies is not a mere

result of hazard, but of a biochemical defect, viz., a deficiency of organic phosphorus. In the Asiatic coolies it is due, I believe, to what hygienists term an "unbalanced diet," their main food consisting of polished rice, the milling of which deprives it of its pericarp, which contains its soluble compound rich in phosphorus pentoxide. Idiocy does not follow because thousands of years have adjusted the "yellow" race to its use. In the Mongolian idiot the deficiency of phosphorus occurs, we have seen, as a result of hypothyroidism, the brain, as well as other tissues, failing to receive the nucleins required for its complete development.

Treatment.—Mongolism is regarded the most rebellious of all forms of idiocy, judging from the literature of the subject. Comby, for example, who urges rightly that it is more frequent than is believed, writes that the results of treatment have not been found encouraging. Some good, it is stated, may be effected by hygienic means, especially good and substantial nourishment and country air, while in mild cases satisfactory results may be obtained by appropriate education. Other authors have tried in turn: thymus, thyroid, the iodides, mercury, etc., the whole gamut, in fact, of agents suggested by any possible etiological factor that the history of a given case might indicate, but without avail.

Our efforts should tend, if better results are to be attained, in two directions, prophylactic and remedial.

As to *prophylaxis*, we should be constantly on the watch for Mongolism when the causative conditions, aged parents, marked discrepancy in the age of parents, prolific parents with the new infant as last offspring, strong

mental emotion of affliction in the mother, syphilis and alcoholism are features of the parental history. A very quiet and "good" baby, giving the parents so little trouble that they take pride in mentioning it, may be found, on examination, to show the facial characteristics of Mongolism. With unusually loose joints, as shown by an abnormally wide range of motion, unusual helplessness and muscular asthenia, as shown by inability to hold up its head, when it should do so, etc., and the various symptoms described in the preceding pages, a diagnosis as applied to the infant is warranted. *Treatment of the infant through the nursing mother, i.e., wet nursing is then indicated.* Artificial food under such conditions will favor the development of idiocy; hence **artificial foods are to be avoided.**

Organic products are now known to be transmitted to the child through the maternal milk. This may be taken advantage of to modify the trend of the infant by supplying to its body the organic products it needs for its development. **Thymus gland**, 5 grains; **thyroid gland**, 1 grain; and **pituitary gland**, 1 grain (to replace adrenal gland advantageously), three times a day should be given **to the mother during meals**, with a varied diet, and, as much as possible, out-of-door life.

The older the little patient when first seen, the smaller are the chances of success. Yet in all some improvement is obtained by means of the **organic agents** given jointly, the doses mentioned for a nursing mother being suitable for a child of 5 years. The dose of **thymus** may be gradually increased until, if need be, 15 grains are given three times a day. If the stigmata indicating insuffi-

ciency of any one special gland are especially prominent, the dose of that gland can at least be tentatively increased. The **hypophosphites**, to enhance the nutrition of the cerebro-spinal system, and **iron** to assist in building up the hemoglobin are of signal advantage. A **substantial and varied diet** is likewise indicated.

The mental status may be materially improved, but at the cost of much patience and perseverance. The imitative instinct of the little patient should be taken as starting point of a **systematic education**, selecting a **special line of work**, music for instance, to which the child is normally attracted, as the main aim. He should not be deprived of the company of normal children, the excitement and fun involved, and the **out-of-door exercise** doing much to enhance the functional activity of his ductless glands. S.

[Henceforth, the diseases will be given as described by Dr. Rohé in former editions of this work. His text, which has had to be shortened in a few instances, but without in any way modifying the views expressed, will appear in *large type* and end with his initial, R, while my own text will appear in *small type* between brackets and will be signed S., as previously stated.]

IDIOCY AND FEEBLE-MINDEDNESS.

Under this title will be grouped those forms of idiocy, imbecility, feeble-mindedness, etc., which are usually treated apart from those already reviewed.

IDIOCY AND IMBECILITY.—

These two conditions of defective mental function are merely different in degree. They are both dependent upon defective or arrested cerebral development. This defective development may be hereditary, congenital, or acquired;

that is, it may occur in intra-uterine life, during the parturient process or after birth. In the United States idiots and imbeciles are generally grouped under the term "feeble-minded."

Idiots sometimes appear to be without any intellectual development whatever, having no power of thought, memory, or judgment. But these extreme degrees, if they occur at all, are rare. The sensory organs may be normal, and the vegetative functions well performed.

In imbecility the arrest or perverted development of the brain has not proceeded to the same degree, and there is more or less intellectual power. The memory and certain special faculties, as the musical, are sometimes highly developed in imbeciles.

SYMPTOMS.—The physical stigmata of degeneration are well marked in idiocy. Of these the most notable is microcephaly, or abnormal smallness of the cranium. This may be due either to imperfect growth of the brain from intrinsic causes or to premature closure and ossification of the cranial sutures.

[As we have seen, defective development of the osseous system is dependent upon thymic insufficiency owing to the deficient formation of calcium phosphate this entails. S.]

In contrast to microcephaly, many cases of idiocy show a larger skull than normal. In these cases there is usually hydrocephalus, which may sometimes be extreme. Irregularity or asymmetry of the skull and brain is also present at times. Defective development of the remainder of the body is frequent.

Pareses and paralyses are among the physical symptoms often noted. Epilepsy and other forms of convulsions are also frequent complications. There

may be various tics, athetosis, and atrophy of paralyzed limbs.

[We have seen that the ductless glands take an active part in the defensive functions of the body. Deficient activity of these organs entails, therefore, accumulation of toxic wastes which should be hydrolyzed and converted into eliminable products. By accumulating in the blood and tissues these and other endogenous poisons cause various disorders, the nature of which depends upon the inherited susceptibilities of the patient. In most instances, however, there are sclerotic areas in various portions of the brain which incite convulsions when the toxic wastes accumulate in the blood beyond a certain limit. The pareses and paralyses are also due in the main to the sclerotic areas. S.]

Strabismus is common. Deafness is extremely uncommon among the feeble-minded; on the contrary, an acuity of hearing, with a considerable development of the musical sense, is not infrequent.

Psychical Symptoms.—The defective intelligence is the most marked characteristic of the idiot. There may be shrewdness, or rather cunning, a retentive memory, acuteness of the special senses, and even the mathematical faculty may be highly developed in certain directions, but judgment and self-control are lacking. There is nearly always defect of articulation; indeed, articulate voice may be absent altogether, the only vocal sound the idiot can make being an inarticulate cry. The expression is generally placid and good-natured. He seems often to feel the necessity of guidance, and fawns upon those with whom he comes in contact. At other times, however, especially when his training has been neglected and he has acquired bad habits, his expression may become brutified.

Self-control is often lacking. The slightest irritation causes an outbreak

of rage during which he may commit violence. Sexual instincts are often active. Masturbation is frequent and its constant practice still further brutifies the defective subject. The uncontrolled sexual desire may also lead to offenses against morality in both sexes. Sexual perversion is not infrequent.

[These cases are often due to deficiency of the thymus during development. This condition entails compensative abnormal development of the sexual organs, and undue excitability of these structures. Again, irregularity in the development of the brain often entails exaggerated activity in the sexual sphere. S.]

There is often a perversity of character, a collection of bad habits, which make the idiot or imbecile an extremely offensive companion. He will strike without provocation, spit at those who endeavor to correct him, and he seems to have an especial tendency to soil his clothing with excretal matters. It is very probable that these habits are the result of bad training, some of them being adopted as means of defense against those who use the idiot as a butt for their miscalled pleasantries.

The so-called "moral idiot" belongs to the same class with the other idiots. While his apparently total lack of regard for the moral law is the most prominent of his characteristics, a careful examination and consideration of his history will show that the essential feature of his malady is weak-mindedness.

Cretinoid idiocy differs entirely in pathology and etiology, as we have seen.

[In 258 cases examined by Bullard (Boston Medical and Surgical Journal, May 5, 1904), it was possible to determine the probable origin in 176. Of these 113 were congenital, 63 were non-congenital or acquired cases. The causes of non-congen-

ital idiocy and imbecility were trauma and disease. Trauma was possibly responsible for 19 per cent. of the cases. The most prolific causes of congenital idiocy and imbecility noted were alcohol, syphilis, uterine disease, and the accidents of labor.

As I have long urged, syphilis and alcoholism are both, as to remote effects, powerful depressants of the functional activity of the ductless glands. The child inherits this condition and suffers from its consequences. S.]

A considerable proportion of cases of feeble-mindedness is doubtless due to traumatisms during the process of birth. Prolonged labor, subjecting the brain to undue compression, direct traumatisms from the use of instruments or improper methods of delivery; convulsions in the mother, with consequent poisoning of the fetal blood by carbon dioxide or by anesthetics used to relieve the maternal convulsions; or premature birth may produce such a disturbance of nutrition in the brain as to arrest or retard its development. It is probable that the number of children in whom the arrest of development has begun at the time of birth is much greater than is generally supposed.

Acquired idiocy, beginning in infancy or childhood, is due to the toxic influence of infectious diseases, to injuries, rachitis, meningeal inflammation, fright, convulsions, and improper training.

[Heredity in this connection should include, among its various factors, inherited inadequacy of the ductless glands, all of the disorders enumerated being such as to insure this result, with alcoholism as an important factor, especially if *conception occurred during drunkenness* of either parent. The nucleins, of which the heads of spermatozoa mainly consist, seem to impart their defective dynamism to the ovum under such conditions; for the nervous system, as a whole, shows evi-

dences of deficient development. While the two special types previously described show the stigmata of one or more ductless glands, the type described under the present heading is one in which all ductless glands are fundamentally deficient. S.]

ETIOLOGY.—Idiocy and imbecility are hereditary in about one-half of all cases. The principal conditions in the ancestry supposed to influence the heredity are: insanity, nervous diseases, intemperance, consanguinity, and tuberculosis. Contrary to general belief, intemperance in the parents is a factor in only about 10 per cent.

[Of all the influences enumerated, that of infectious diseases is the most pernicious in so far as the ductless glands are concerned. All of the diseases of childhood of this type expose the various ductless glands to considerable danger, by causing in them hemorrhagic areas, foci of necrosis through autolysis, abscess, etc., which become converted into fibrous patches that reduce correspondingly the efficiency of the organs. When a considerable proportion of the thyroid, for example, becomes fibrous, cretinism may result; when several of the glands are similarly affected, the development of the whole organism is compromised, including that of the brain; when the thymus is the seat of fibrous lesions, the osseous and nervous systems suffer most, etc. The pituitary is affected in the same way, Frohlich's adipositas cerebri being then caused, etc. Much idiocy and imbecility will be prevented when the evil influence of infectious diseases in their genesis will have been duly recognized and appropriate measures undertaken to prevent involvement of the ductless glands. These measures will be mentioned under prophylaxis. S.]

TREATMENT.—The treatment of feeble-mindedness should be primarily prophylactic.

[The *prophylaxis* of idiocy should be adopted as a habit by the medical man, with *all* infants. Besides being on the

alert for ductless-gland stigmata, he should urge upon mothers the importance of **breast nursing** as a preventive, and insist upon it if any stigmata appear. If defeated in his efforts, **fresh-drawn milk**, cows' or preferably **goats' milk**, should be ordered, any delay in its use entailing the chemical destruction of nucleins and other substances necessary for the ductless glands. Many of the mental disorders of childhood, including idiocy, would be prevented if in all febrile infections disorders such as measles, scarlatina, diphtheria, etc., hypodermoclysis, or, at least, **saline solution** per rectum or as beverage, were employed to promote the fluidity of the blood, enhance osmosis and thus prevent autolysis to which the lesions in the delicate ductless glands are due. S.]

If anatomical defects are at the base of the feeble-mindedness, no method of treatment known offers any chance of improvement.

[The importance of prophylaxis is emphasized by the frequency of organic lesions in the brain: sclerosis of one or both hemispheres, a lobe, a convolution, etc.; chronic meningitis; vascular obliterations, etc., which paralyze our efforts. S.]

In cases where premature synostosis of the skull is certainly present, there should be no hesitation to do Lannelongue's operation of **craniectomy**. The results of the operation have not been generally encouraging.

[Time has verified Bourneville's opinion that craniectomy had no anatomical or physiological grounds. After a slight temporary improvement the patient resumes his morbid condition. S.]

The main reliance must be placed upon good **pedagogic methods**. The idiot must be taken in hand as early as practicable by a qualified teacher. Correct habits must be taught and their practice enforced by constant supervision. The idiot must be looked upon as an unfortunate, and not as a pervert with criminal instincts. Endeavors

must be made to lead him to correct behavior. It will be found usually much easier to lead than to drive him. R.

[Besides the education and hygienic measures, which have been developed to their highest possibilities, medical treatment sometimes proves of avail if the stigmata in each case are traced and the defects they indicate are, where possible, corrected. The younger the patient, the better are the chances of improvement. If thymic stigmata are discovered, **thymus gland** should predominate in the treatment. From 5 to 30 grains (0.3 to 2 Gm.) can be given three times daily in a child of 5 years. The **syrup of hypophosphites** aids materially. If the osseous system shows tangible lesions, **calcium lactate** is necessary to compensate for the habitual loss of calcium which these cases show. Myasthenia and other muscular disorders of an adynamic type call for **adrenal gland**, 5 grains (0.2 Gm.) three times a day, gradually increased until cramp-like symptoms in the muscles are noticed. **Thyroid gland** in tonic doses is a necessary adjunct in practically all cases, even if myxedema stigmata are not found. In females, **ovarian gland** or **lutein** may replace the adrenal gland. Two or three glandular preparations may be given together, provided they harmonize physiologically. **Iron, digitalis,** and **strychnine** prove useful where the usual indications for these agents prevail. S.]

GROUP II. PSYCHOSES DUE TO A VICIOUS OR ABNORMAL BRAIN-ORGANIZATION (ALWAYS HEREDITARY).

PARANOIA.—This disorder is considered in the article on DEMENTIA PRECOX in the third volume, to which the reader is referred.

[**Dementia Precox.**—Much is being done to elucidate our knowledge of this all-important disorder at the present time, precisely in the direction of the ductless glands. It would be premature, at the present time, to present conclusions. Besides the treatment recommended by Prof. Ingham, in his article in the third volume of this work, mention may be

made of the fact that **thymus gland** has been tried by Ludlum and Corson White in 6 cases of the disease; in 3 it gave excellent results; the remaining 3 cases were of old standing. **Thyroid gland** has also been found useful by Davidson (Australian Med. Gaz., Apr. 20, 1911), and by Levison (Hospitalstidende, No. 36, 1909), in a case of the *hebephrenic type*. In a few instances noted by Berkeley, Winslow, and others **partial thyroidectomy** gave favorable results in the *katatonic type*. As is well known, arsenic depresses the functional activity of the thyroid. Now, Lundvall has claimed cure in 30 per cent. of his cases by injecting subcutaneously, when the blood showed a polycythemia and leucopenia, 2 to 20 c.c. of a solution made of:—

<i>Arsenic trioxide</i>	0.05 part.
<i>Sodium nucleate</i>	100.00 parts.
<i>Sodium cinnamate</i> ...	10.00 parts.
<i>Distilled water</i>	400.00 parts.

This should be sterilized before using and injected warm, repeating the dose as the resulting leucocytosis has subsided. The treatment is to be continued a long time. S.]

RECURRENT INSANITY.—

Definition.—Recurrent or periodic insanity appears as states of exaltation (mania), depression (melancholia), or an alternation of the two (circular insanity), with intervals of apparent lucidity. Periodic dipsomania is one form of recurrent insanity. The tendency to recur persists throughout life, and dementia is rare.

RECURRENT MANIA.—The essential feature of recurrent mania is the occurrence of exaltation of feelings without any confusion of ideas. The usual symptoms of mania (*q. v.*) probably dependent upon cerebral hyperemia come on often without any apparent prodromic symptoms of depression. After a month or longer in the exalted stage, the patient gradually, sometimes suddenly, returns to his

normal mental condition, which, however, is not to be mistaken for recovery. The victim of periodic insanity exhibits even in the intervals evidences of some involvement of the intellectual functions. The inherited tendency to mental disturbance is always discoverable.

During the attack there is usually some loss of weight. The first attack most frequently occurs at puberty. In women succeeding attacks often coincide with the menstrual period.

[The periodicity of this disorder points to a toxicosis due to inadequate functional activity of the entire protective mechanism with elevated blood-pressure as cause of the cerebral hyperemia. It is a tidal wave, as it were, of waste products, the morbid phenomena of which last until eliminated. S.]

Prognosis.—Permanent restoration of normal mental function does not occur. Individual attacks are, however, recovered from and the patient remains apparently well until the next outbreak. The intervals between attacks may be weeks, months, or years. In one case now under observation the intervals are about two weeks. Dementia is rare.

Treatment.—**Chloral** and **bromide of potassium** may be given to depress the circulation and cerebral exaltation. **Sulphonal** has given the best results; 15 to 20 grains (1 to 1.3 Gm.) are given every four hours and the quantity rapidly reduced as the maniacal condition passes away. In most cases the drug can be reduced to 5 or even 3 grains (0.3 or 0.2 Gm.) at a dose in the course of three or four days. The effects of the remedy upon the kidneys should be carefully watched. **Bed-rest, baths, and nourishing food** are essentials in the

treatment equally as important as medical agents. R.

[In these cases **thyroid gland** in 2-grain (0.13 Gm.) doses three times daily is sometimes advantageous. The large doses usually given are more harmful than beneficial by causing inordinate tissue catabolism and accumulation in the blood of toxic wastes. Where the disorder is connected with the menstruation of menopause **ovarian gland** 5 grains (0.3 Gm.) or **corpus luteum** in 2-grain (0.13 Gm.) doses should be given with the thyroid gland.

Careful **search** for any **source of intoxication** (teeth, intestines, etc.) or infection (tonsils, nasal cavities, vagina, etc.) should be made. The intestinal canal should be kept free by **frequent purgation**. When the attacks are about due, **saline solution** by the rectum or subcutaneously should be tried. Where any gastric disorder is present, **gastric lavage** is indicated. S.]

RECURRENT MELANCHOLIA.

—The symptoms are usually those of simple melancholia without delusions; the attacks come on rapidly, and after a duration of some weeks or months disappear as quickly. Here is profound depression, loss of appetite, headache, and insomnia. The outlook is favorable, so far as the individual attacks are concerned, but permanent recovery does not occur.

Treatment.—The favorable effects of opium as manifested in ordinary melancholia are not so pronounced in the recurrent variety. Krafft-Ebing recommends the following for its ameliorating effects:—

R. *Sodii bromidi* ℥iiss (10 Gm.).
Antipyrini gr. xlv (3 Gm.).
Codeini hydrochlorat. . gr. v (0.3 Gm.).
Aquæ destill. ℥iv (120 c.c.).
Syr. menthæ pip. ℥v (20 c.c.).

M. Sig.: A teaspoonful, gradually increased to 7 as required, twice a day. R.

[The causes of this condition and its treatment are, on the whole, the same as those described below under Melancholia, q. v. S.]

CIRCULAR INSANITY (ALTERNATING INSANITY).—This is a form of insanity in which states of mania and melancholia alternate with each other with or without lucid intervals intervening.

Symptoms.—The disease may begin with mania or melancholia. The initial mental disturbance, of variable duration, is followed, either directly or after a lucid interval, by the opposite condition. The duration of the cycle may be weeks, months, or years. In some cases there are marked delusions. The maniacal stage is usually one of simple exaltation.

[This disease also bears the imprint of toxemia, but combined with exaggerated activity of the ductless glands when these are caused to react by an accumulation of toxics. Exaltation of the cerebral sphere occurs under the temporary excess of oxidation to which the cells of the cerebral neurons are exposed. This active reaction is succeeded by exhaustion of the various glands and the melancholia is aggravated through deficient oxidation of the cerebral neurons. S.]

The diagnosis is only possible after prolonged observation or when a trustworthy history of previous attacks can be obtained. Cases with lucid intervals between the stages of depression and exaltations are rare.

The prognosis is unfavorable. The duration of the disease is for life. Dementia does not occur except in advanced stages. The exhaustion of the maniacal stage may shorten life.

Treatment.—The treatment is unsatisfactory. Chloral fails to quiet the exaltation and restlessness in the maniacal stage, unless given in such doses as to be dangerous. In like manner, opium is usually of little benefit during the stage of depression. When possible, **rest in bed**

should be enforced, especially in the stage of excitement. R.

[**Thyroid gland** is clearly indicated in these cases during the period of melancholia. During the maniacal period, however, it can only do harm. The **cause** of the **toxemia** should be sought and if possible **eliminated**. During the period of exaltation **chloral** and **sodium bromide** given together are often helpful where either of these drugs given separately will prove ineffectual. S.]

GROUP III. PSYCHOSES DUE TO SIMPLE DISTURBANCE OF NUTRITION (ANEMIA AND HYPEREMIA) OF THE BRAIN.

MELANCHOLIA.—Definition.—

Melancholia is a form of mental disturbance characterized by profound mental depression with suicidal tendencies. Its physical basis is supposed to be anemia of the brain.

[Melancholia is now attributed to auto-intoxication. Indigestion and constipation are usually present and absorption of toxics from the intestinal canal is shown by indicanuria and the presence of ethereal sulphates in the urine. S.]

Symptoms.—The symptoms of melancholia are physical and mental.

First in importance are those referable to the digestive organs. There is nearly always profound anorexia, often resulting in obstinate refusal to take food. This may be due to gastric disturbance, but is more frequently the consequence of visceral hallucinations and delusions which will be referred to later. The tongue is usually coated and the breath offensive. Constipation is nearly always present.

Involuntary defecation is frequent, not because the patient has lost control over the sphincters, but on account of inattention to the sense of fullness in the rectum.

In women there is usually arrest of

menstruation. The urine is generally somewhat diminished in quantity and rich in phosphates. That of melancholiacs is much more toxic than normal urine; that of maniacs is less toxic.

Sexual desire is usually diminished.

In nearly all, perhaps in all, cases of melancholia there is depression of nutrition. The red blood-corpuscles and the percentage of hemoglobin are generally reduced.

There is usually considerable loss of weight. The skin is usually dry and harsh. The force of the circulation is diminished. There is usually passive congestion of the blood-vessels.

[While autointoxication is a feature of melancholia, the severity of its effects is doubtless due to the simultaneous presence of hypothyroidism, as shown by the dry and harsh skin, and of hypoadrenalism, suggested by the general vasodilation and sluggish circulation. This denotes deficient antitoxic activity of the body fluids and explains the pathogenic accumulation of wastes. S.]

MENTAL SYMPTOMS. — The mental symptoms of melancholia are depression, hallucinations and illusions, delusions, fear of death, and tendency to suicide. The last named is potentially present in all cases, but is active in many.

In simple melancholia there is profound depression, with a fear of never recovering either physical or mental health. In these cases the memory and judgment are usually preserved, but the patient is so entirely under the control of the depressive emotion that he cannot think normally.

In melancholia with delusions, the latter are usually those of self-accusation, self-abasement, or of justifiable persecution. The melancholiac feels that he is justly punished by God for some transgression, real or imagined.

Indeed, he fancies usually that his punishment is entirely inadequate to the transgression.

The melancholiac seeks death either because he thinks he merits it, or—and this is perhaps more frequently the case—to escape from mental distress, which becomes unbearable.

One of the most persistent delusions of melancholia is that there is destruction of the abdominal viscera and that no food can pass; that, if taken it will not pass and that it will cause the patient's death if forced upon him. The complaints of being "rotten inside" are frequent among melancholiacs. These sensations of obstruction may be real, and that an actual stenosis of the bowel may be present. Such cases have been reported by Clouston and by me.

The delusion that the patient has committed "the unpardonable sin" or "the sin against the Holy Ghost" is an extremely obstinate one. Savage regards this delusion as an unfavorable one, as patients manifesting it—"the unpardonable sinners," as he calls them—rarely recover. The nature of the unpardonable sin varies with different persons. Most of them can not or will not define it.

In some cases the fear of impending death colors all thoughts and actions of the patient. Food and medicine are refused, because the patient will presently die. Nothing can be done to prevent it. In other cases all friends have deserted the patient, and there is nothing left but to die.

Most melancholiacs are more or less passive and quiet; beyond making verbal complaints of their sufferings they sit and brood over their troubles, which are always real to them. In other cases, however, there is great restless-

ness. The patients are constantly in motion, crying and lamenting; sometimes under the stress of their delusions there are outbreaks of violence, although these are rare.

The suicidal tendency is present in a large proportion of melancholiacs. Life is usually taken by violent means. Hanging, shooting, jumping from a height, cutting the throat, and drowning are the most frequent methods. Even such painful methods as burning and swallowing broken glass are resorted to. The attempts are sometimes very persistent.

Sometimes melancholia is combined with a stuporose condition,—“melancholia with stupor.” In these cases the patient sits or stands all day long, mute, apparently taking no note of anything going on around him. There is sometimes also resistance to everything done for the patient.

Etiology.—Anything that depresses the general nutrition in one predisposed to insanity may cause melancholia. The essential physical substratum of the disease is probably cerebral anemia, although at present the morbid anatomical condition of the brain in melancholia is not known.

[Improvement of the mental symptoms coincides with better health. According to Farquharson, hereditary predisposition exists in 38 per cent. There must, therefore, be an existing cause; exhausting diseases such as cancer, tuberculosis, alcoholism, prolonged lactation, emotions, starvation, and other depressive influences are the main causes of the disorder. They all lead to functional deficiency of the ductless glands. This, in turn, prevents the destruction by hydrolysis of toxic waste products which play an important rôle in the production of the disease. Briefly, the latter should be considered as a toxemia with vasomotor depression and cerebral anemia. Where high blood-pressure exists, the degree of toxemia is high. S.]

In about one-half of all cases there is a psychopathic ancestry.

Diagnosis.—In many forms of insanity psychical depression is a stage in the development of the disorder. Thus, mania mostly begins with depression; in general paresis, although the feelings are usually exalted, there may be a depressive stage lasting nearly throughout the disease. Many cases of paranoia have a melancholy tinge, and in the toxic psychoses depression is not an unusual symptom. True melancholia must, however, be differentiated from these episodic depressions.

In true melancholia every emotion, thought, and act is dominated by the sense of profound depression. Nothing can dissipate the cloud of sadness that envelops the patient. He is lost; there is neither relief for him in this world nor salvation in the next.

The prognosis is generally favorable. Under appropriate treatment, from 75 to 80 per cent. of cases should recover.

Treatment.—One of the first questions usually asked the physician who is consulted in a case of mental disturbance is: Can the patient be treated at home, or is removal to an institution necessary? In cases of melancholia **home treatment** is often practicable, if an attendant **with tact and firmness** is secured. Even under these favorable circumstances, however, treatment in an institution should be advised. Refusal of food and medicine must be met with positiveness, and in case of resistance **forcible feeding** must be practised. It is rarely necessary to resort to the nasal or esophageal tube, and, in those cases in which it must be employed, a few trials are usually sufficient and the patient will thereafter

take his meals with a little coaxing. It is not sufficient to know that the patient eats; the physician must assure himself that the quantity of food is sufficient to maintain the standard of normal nutrition.

As refusal of food is sometimes due to gastric or intestinal disorders, the patient should always be carefully examined to determine whether the gastrointestinal canal is in normal condition. Catarrhal conditions demand appropriate treatment, and want of digestive power may, at times, be relieved by **tonics**, stimulants, and digestives. For brief periods, **concentrated or partially digested foods**, such as beef-juice, clam-juice, peptones, etc., may be employed with benefit. **Nux vomica** or **strychnine**, **quinine**, **phosphorus**, or **codliver oil** will often be found of use.

[**Thyroid gland**, 2 grains (0.15 Gm.); **thymus**, 5 grains (0.33 Gm.); **pituitary**, 1 grain (0.06 Gm.), and **strychnine**, $\frac{1}{60}$ grain (0.001 Gm.) in a capsule *t. i. d.*, by promoting the patient's defensive powers, antagonize directly the cause of the disease. S.]

The systematic use of **stomach-washing** also promises good results in these cases.

There is usually constipation in melancholia. This should be counteracted by the nightly administration of **compound licorice powder**, **cascara sagrada**, or one of the usual anticonstipation pills. A **mercurial** followed by a **saline purgative** is good initiatory treatment, and a weekly repetition of the mercurial will be found beneficial.

[An essential feature in this connection, is as much as possible the preservation of intestinal asepsis. **Menthol**, **salol**, or **creosote carbonate**, the latter in 5-grain (0.3 Gm.) doses in capsules thrice daily after meals, is useful for this purpose.

Secretogen, a preparation of secretin, in large doses before meals, enhances intestinal digestion. A **calomel** purge weekly and a reliable **lactic acid bacillus** preparation have given excellent results. High colonic irrigations of **saline solution**, retained as long as possible, aid materially the renal elimination of waste products. S.]

Perhaps the most important remedy in acute melancholia is **rest in bed**. The depressed state of nutrition is a strong indication for bed-rest. It will be found that the patients quickly respond to the good effects of this treatment. **Supervision of suicidal cases** is also much easier if patients are kept in bed.

The production of sleep is most important. Depressing hypnotics, such as chloral, bromide of potassium, etc., are not beneficial. If an hypnotic is necessary, **sulphonal** or **paraldehyde** should be used. **Chlorobrom** and **codeine** have been recommended.

[**Veronal** is now preferred by some psychiatrists as hypnotic. S.]

A pint of **ale** or **beer** or a glass of **whisky and water** is often a better hypnotic than the medicines mentioned.

The tendency to suicide in melancholia requires careful and **constant watchfulness**. The patients with suicidal tendencies often display great shrewdness in lulling the suspicions of those having them in charge. The most attentive and watchful nurses are liable to relax their care, and, before preventive measures can be adopted, the patient has secured a weapon and taken his life. The attendant upon a melancholiac must have an intelligent appreciation of the patient's condition and of the persistence of suicidal impulses.

The medicinal agent of most value is opium. Many alienists object to its use on account of the alleged danger of contracting the opium habit, but when the drug is disguised and is systematically administered, this danger can be guarded against. It is best given in the form of **deodorized tincture of opium** disguised with **whisky** and combined with a laxative, as **cascara**, to diminish the constipating effects of the remedy. The latter, however, are not very marked after the medicine has been taken a few days. The beginning dose is 5 minims (0.3 c.c.) of the deodorized tincture, gradually increased to 30 or even 40 minims (1.8 or 2.4 c.c.) twice a day. Stress is laid on the regular administration of the drug. When opium or morphine are given at regular times to reduce anxiety or produce sleep, it fails entirely in producing its beneficial curative effect in melancholia. When the desired effects (quiet, diminution of intensity of hallucinations and delusions, disappearance of mental depression) have been obtained, the dose is gradually reduced to the vanishing point.

[The use of opium and its preparations is feared by most practitioners, lest it add the opium habit to the patient's misfortunes. **Codeine** is now preferred to other preparations. S.]

In some cases the opium produces so much gastric irritability that it must be suspended. These are, however, very few. **Sulphonal** 30 grains (2 Gm.) each night is a good substitute. R.

MANIA.—Definition.—An abnormal exaltation of mental activity, with incoherence, hallucinations, illusions, and delusions of variable character. There is reason to believe that mania

is accompanied by an hyperemia of the cerebral cortex.

These symptoms may all occur as a stage in some other form of mental disturbance. Thus, paranoia, general paresis, gross brain disease, and developmental psychoses may have maniacal attacks as part of the clinical history. In true, uncomplicated mania the exaltation is the characteristic manifestation.

Symptoms.—An outbreak of mania is usually preceded by some days or weeks of depression or irritability of the patient. He loses appetite, the sleep becomes disturbed, and there is observed a disinclination to his usual occupation. Sometimes there is headache, or a sense of pressure in the head. These symptoms, after a time, become changed in character. The depression disappears, the patient feels exalted and becomes talkative. If asked about his health, he will tell you he is well—"never felt better in his life," etc. Schemes for his own advancement or that of others are regarded in an optimistic spirit. Visits are made to friends and acquaintances and private business affairs are discussed with more prolixity and less reserve than are usually agreeable to others concerned. The recollection of past events is sometimes very accurate and the minutest and least important details of some long-past transaction are often recounted in the most wearying manner for the hearer. The patient in this stage does not care whether you reply to him or not. He only wants a good listener into whose ears he can pour his connected or disconnected verbosity. He also usually becomes a voluminous letter-writer. In some cases there is a tendency to make rhymes which are sometimes very ingenious. This must

be differentiated from the verbigeration or chattering of delirium or of acute confusional insanity.

The persistence of hallucinations and delusions in melancholia and paranoia is usually absent in mania. In this form of mental disturbance there is usually rapid change of delusions and hallucinations, often without apparent cause. The false sense-perceptions and ideas vary as rapidly as they sometimes do in dreams.

If unopposed in his irrational notions, the patient is usually in a cheerful, even happy frame of mind. Contradiction or opposition soon lead to irritability, and at times the patient may become so angry as to be uncontrollable. Under these circumstances maniacs may commit acts of violence, the patient's anger being entirely beyond his control. On the other hand, if the delusions are encouraged they "increase by what they feed on" and grow more persistent and insistent.

In connection with the mental exaltation there is often great restlessness. The patient may continue doing his usual work, but he does everything in a hurry. There is a more lively play of the facial expression. The patient frequently poses for effect. This is perhaps equally frequent in the two sexes, although more marked in women. Sexual desire is also enhanced, and in advanced stages women are likely to exceed males in obscenity of speech and action. Masturbation is sometimes observed in mania, but much less frequently than in epileptic insanity. The open practice of the vice is comparatively rare.

In the more severe forms of mania all these manifestations are intensified. The rapid movements, the shouting and laughing, incoherence, obscenity, and

profanity are greatly heightened in degree.

Articles of clothing, bedding, furniture, in short, anything that offers opportunity for tearing or breaking, are liable to suffer destruction at the hands of the maniacal patient. He loses control over his sphincters, and wets and soils his bed and clothing, or defecates on the floor and then dabs his body or the walls of his room with his excreta. There seems to be anesthesia in some cases; at all events slight injuries, that in the normal condition would give rise to complaints of pain, are either not felt or are thought unworthy of notice.

Fever is present in a considerable proportion of cases of acute mania. It should always lead to a careful physical examination to determine the presence of any local inflammatory condition or abscess. Mere functional derangement of the mind is not likely to cause appreciable elevation of temperature. There can nearly always be found some direct cause for the fever, either inflammatory or septic. The inflammation may be in the brain or its membranes, in the abdominal viscera, the pelvis, the external ear, the integumentary tissues, or the peripheral nervous system (neuritis). The septic infection may start from a wound, an abscess, or a diphtheritic patch, or it may be in the blood itself, as in various specific febrile conditions. Even when no physical cause can be discovered, fever is always a grave symptom, since, if it rises too high, exhaustion supervenes more rapidly.

The pulse in mania is usually full and regular. But when there is beginning exhaustion, as in those cases where the patient is constantly moving about, with insufficient food and sleep, the pulse is small and rapid. In these cases

death from exhaustion is not infrequent.

An attack of mania may terminate in one of four different ways: (1) recovery; (2) death from exhaustion; (3) chronic mania; (4) consecutive dementia.

Etiology.—Aside from the influence of heredity, which can be traced in one-half or more of the cases, prolonged excitement of the cerebral centers, overwork, and mental strain of various kinds may be regarded as etiological factors.

[That all forms of acute mania are due to some toxic endogenous or exogenous has been maintained by many. If such is the case, it would appear to be one capable of causing *paresis* of the cerebrospinal vessels and passive hyperemia of the cerebrum. The causes enumerated above are such as to produce exhaustion and not excitation. A great excess of arterial blood in the cerebrum is observed *post mortem* in these cases.

That deficient activity of the ductless glands prevails in these cases can only be surmised. Yet, when we compare the acute phenomena with those that occur during the sthenic stage of Graves's disease, it appears rational to conclude that there is overactivity of the ductless glands to oppose the toxemia, and that the maniacal phenomena are partly due to this process. The stage of exhaustion also occurs in Graves's disease. S.]

Prognosis.—Recovery occurs in about 70 per cent. of cases. When recovery follows it is usually only after several months, from six months to a year being the usual duration of an attack. The recovery is rarely sudden, or gradually progressive. More often the patient improves for a time, to drop back in a day or two into a condition of excitement, followed again by improvement, and thus recovery is reached by a series of stages of improvement overlapping a series of re-

lapses. In other cases the passing off of the stage of excitement is followed by one of depression, out of which the patient gradually awakes to his normal mental activity.

Death from exhaustion usually occurs early. Ordinarily about 8 to 10 per cent. of the cases of mania die from exhaustion. Under early and proper treatment, this proportion should be much diminished. Of the remainder the larger proportion results in progressive brain degeneration, presenting the characters of consecutive dementia. According to Willerding, about 70 per cent. of all cases of acute mania are cured after running a course averaging several months.

Treatment.—The treatment of mania often requires great tact, perseverance, coolness, and command of therapeutic resources. In the first place, in case of any gravity, **home treatment** is generally **impracticable**. The noise, the motor unrest, the constant **expert attention** required, and the violence toward others make it incumbent in most cases to remove the patient to an institution for the insane. It is customary in most hospitals for the insane to isolate the maniacal patient. In the writer's experience this sequestration is not to the patient's advantage. Keeping the patient in an open ward, preferably in bed, in the presence of other patients, constantly suggesting to him by précept and example that he is sick and requires treatment will usually soon quiet the most excitable maniac. It may be necessary to keep one or more attendants by the bedside all the time, to prevent him from getting up and running about and so exhausting himself. A bath, clean linen, and quiet, tactful nursing will do wonders in calming the excite-

ment and dissipating the delusions of the maniac.

Careful attention must be paid to the bodily functions. A useful preliminary is a large **enema** to remove fecal accumulations and prevent soiling of the bed. Feeding with **nutritious food** is of the first importance. Maniacs usually eat ravenously anything offered them. Care should be taken to prevent overloading the stomach with indigestible food. If the **pulse** is **weak** and rapid, the addition of a moderate quantity of **alcohol** is often useful. Milk and eggs, with beef-juice, or partly predigested beef-powder, and some of the starchy invalid foods are perhaps the best form in which to introduce nourishment. In very active mania, a **warm bath, with effusion of cold water**, is recommended by Binswanger.

[Anderson, of the Claremont Hospital for the Insane, has obtained excellent results from injections of 2 or 3 pints of **warm saline solution** several times daily—a measure which tends greatly to favor the elimination of toxics to which the disease is attributed by many psychiatrists.

Thyroid gland is usually given in too large doses. Not more than 2 grains (0.13 Gm.) thrice daily should be used. Such doses enhance the antitoxic activity of the leucocytes and blood, while large doses cause exaggerated catabolism and an accumulation of its products, aggravating the disease. **Thymus**, 5 grains *t. i. d.*, may be added advantageously during the period of exhaustion. S.]

Sleep must be secured. If it does not follow the measures here recommended within a reasonable time, some hypnotic must be given. Among the hypnotics least likely to disturb digestion or depress the appetite are: bromide of potassium, chloral, hyoscine, sulphonal, and trional. Clouston highly recommends **chloral**, 30

grains, with 10 minims of the tincture of **cannabis indica**. A combination of **sodium bromide** and **chloral**, of each, 15 grains, with 15 minims of tincture of **hyoscyamus** is also an excellent calmative. In cases of great weakness and rapidity of the heart's action, **digitalis**, **strophanthus**, or **strychnine** may be added to the bromide-and-chloral mixture. **Paraldehyde** is a valuable hypnotic in cases with depression. It is given in doses of $\frac{1}{2}$ to 1 dram in $\frac{1}{2}$ ounce of whisky, diluted with a little water. It usually produces sleep within an hour. A bottle of **ale** or **beer** is often an excellent hypnotic.

Opium, which is so useful in melancholia is generally contraindicated in mania. The brain-hyperemia is simply increased by the drug, and the symptoms heightened. In the late stages, however, where there is brain exhaustion and the descent into dementia seems imminent, opium sometimes pulls the patient together and enables him to recover.

Chlorobrom, a mixture of bromide of potassium and chloralamid, is also a satisfactory hypnotic in mania. It does not produce depression or derange digestion.

Duboisine sulphate from $\frac{1}{130}$ to $\frac{1}{40}$ grain (0.0005 to 0.0016 Gm.) has been highly recommended; *hyoscine hydrobromide* in $\frac{1}{8}$ - to $\frac{1}{70}$ - grain (0.008 to 0.0009 Gm.) doses also, both given hypodermically.

After the acute stage has passed the physical strength returns, and the brain begins to return to its normal activity, great care is necessary to prevent relapses. All sources of irritation should be kept from the patient; visits of friends should not be allowed too soon or too fre-

quently, and he should be kept under close observation until the normal mental stability is re-established. R.

GROUP IV. PSYCHOSES DUE TO MICROSCOPIC STRUCTURAL ALTERATIONS IN THE BRAIN (PRIMARILY PROBABLY NUTRITIONAL OR TOXIC).

GENERAL PARESIS.—Definition.—General paresis is a chronic, progressive, diffuse, structural alteration of the cerebral tissue, with involvement of the cortical and meningeal blood- and lymph- vessels, attended by characteristic psychical and motor disturbances. The disease is incurable and leads to death usually within three years.

Symptoms.—No single symptom can be regarded as diagnostic of general paresis, even in the advanced stages.

Among the early psychical symptoms are irritability and especially an instability of the moral and mental character. The subject is easily disturbed, emotional, of variable moods. His memory, especially for recent occurrences, becomes defective. He forgets dates, appointments, mislays valuable documents or other articles. The moral sense is often perverted. He loses that delicate sense of propriety by which his previous life has been guided. He becomes unconventional, consorts with drunkards and lewd females, makes indecent proposals to respectable women of his acquaintance, indulges in a latitude of speech and action not tolerated by the conventions of the social stratum to which he belongs; all this without recognizing any impropriety in it. He may make a public merit of his sociological study of the nude in brothels, and of his compounding with liars and perjurers. He may violate public decency by exposure of his genitals in the street, or show a coarse disregard for

his own household by defecating in bed or urinating on the carpet in his room.

There is progressive inability to concentrate the attention. With the failure in memory, incidents, real or imaginary, are embellished with fanciful details, the truth of which is asserted and maintained with vigor, and all doubts are actively and often angrily combated.

The prevailing character of the psychical manifestations is one of exaltation. Cases occur not infrequently, however, in which the key-note throughout the whole course of the disease is depression. In some instances the diagnosis of melancholia would be justified if the psychical symptoms alone are taken into consideration. Delusions of persecution may also be present, but are generally attended by expansive delusions.

Delusions of grandeur are present in most cases of general paresis, although they cannot be regarded as essential or pathognomonic. Many cases of general paresis run their entire course without manifesting exaltation or expansive delusions at any time.

The delusions of grandeur are not only unreasonable, but the patient's reasons for his extravagant beliefs are either inadequate or he does not give any reasons. While his imagination seems to be vivid, as shown in his delusions, it is, in fact, decreased. His delusions are so unrestricted that the most modest healthy imagination at once recognizes their absurdity.

These delusions are rarely fixed; that is to say, they do not possess the permanent character of the delusions of paranoia. While there is a general sameness of the main feature,—the expansiveness of the delusion,—the individual delusions constantly vary.

As the disease progresses, dementia

becomes more and more marked. The destruction of the intellectual faculties is so complete that toward the last even the delusions disappear. This progressive dementia goes hand in hand with the physical deterioration of the powers, so that when at last death comes to end the scene the vital machine may be said to go to pieces like the "deacon's one-hoss shay."

One of the earliest physical symptoms is persistent insomnia, not yielding to hygienic or medicinal agencies. It is often accompanied by intense and frequently recurring hemicrania. The sleeplessness and pain are believed by many to indicate intracranial pressure; but this is not absolutely certain. Ophthalmoscopic examination fails to show intracranial pressure. In other cases there is an uncontrollable desire to sleep. The patient falls asleep in the midst of his occupation or in company.

Early symptoms also are losses of consciousness varying in degree from momentary dizziness to apparently true apoplectic attacks. They are present in nearly every case and are important diagnostic signs. While they are frequent and severe in the advanced stages, they are often the first indication of serious cerebral disease.

After severe attacks there may be hemiplegia, which, however, usually disappears in a few hours or days. These attacks are evidently not due to rupture or thrombus of the cerebral vessels, but probably to circumscribed edema of the brain, which rapidly passes away.

Convulsions epileptiform in character may also be present as early symptoms, but are usually met with in the later stages.

Sometimes the apoplectic attacks are due to internal hemorrhagic pachy-

meningitis, and in these cases death often follows soon after the stroke.

Frequent among the early symptoms are those connected with the innervation of the iris. The pupil is usually irregular, mostly dilated, more rarely contracted, in the fewest cases normal in diameter. The pupils of the two sides often vary in size and reaction. The reaction to light and sensation may be retarded or entirely abolished. The Argyll-Robertson pupil, so characteristic of tabes, is also a frequent symptom of general paresis. It probably depends upon similar degenerative processes as in the former disease. It is said that the ocular symptoms—inequality of pupils, myosis, and Argyll-Robertson pupil—have been noted several years before the outbreak of the mental disturbances.

Other motor symptoms are changes in the deep reflexes. The patellar reflex is most often increased, but may be normal, diminished, or absent. It has no diagnostic significance except in connection with other physical or mental symptoms.

The facial muscles often show signs of involvement. A fibrillary tremor or twitching of the muscles about the mouth, sometimes a spastic condition of single muscles or groups of muscles about the face, loss of expression from paresis of certain muscle groups may be present. On protruding the tongue, the organ is tremulous or protruded in a spastic or jerky manner. Tremor of the hands is also present as a symptom of the advanced stage. The writing becomes irregular and "shaky."

The speech is jerky, slow, or "scanning." In advanced cases it becomes slurring. Syllables are dropped or repeated. Certain words are pronounced

with difficulty, the test phrase "truly rural" usually running into "toory looral." Later the speech becomes indistinct and finally degenerates into an inarticulate sound, in which no words can be distinguished. The early speech defects are probably due to fibrillary tremor or twitchings of the tongue and lips. The later ones are paretic in origin.

The lines of expression in the face become obliterated in the later stages of paresis, but this sign can at times be noticed among the early symptoms on careful examination.

An early symptom is retention of the urine, which is due to loss of contractile power, or of reflex sensibility in the vesical walls. The overdistended bladder dribbles urine. This may be mistaken for a paralytic condition. In the advanced cases there is dribbling of urine and involuntary escape of feces from relaxation of the sphincters.

An annoying symptom of cortical irritation is a constant grinding of the teeth. This is so often present in general paresis that it is considered by some authors as pathognomonic, but it also occurs in some cases of simple dementia.

The gait in the early stages is spastic or ataxic. In advanced cases it becomes slouching or dragging.

In the advanced stages, coincident with the progressive dementia, is increased motor debility. Tremors or twitchings give place to paresis and these again to complete paralytic conditions. The patient is no longer able to keep on his feet, and after a time he becomes bedfast. The power of articulation is lost and the voice becomes an inarticulate moan, extremely distressing to the hearer.

Mastication of food is forgotten and

masses too large to pass down the esophagus are partly swallowed and often cause asphyxia by compressing the trachea.

Vasomotor disturbances are frequent. The innervation of the vessels is diminished and there follows dilatation of the superficial vessels, redness or blueness of the skin, edema and cyanosis of the peripheral members, and diminution of blood-pressure.

Sometimes there are punctiform extravasations of blood in the skin, and even actual hemorrhages from the mucous surfaces, as from the bowel.

Consequent upon the defective innervation, combined with external mechanical influences (traumatism, prolonged pressure, etc.), trophic changes occur. Othematoma and bed-sores are often noticed, the latter especially when the patients have become bedfast.

The course of general paresis is, as a rule, steadily progressive. Cases occur in which there are remissions, sometimes lasting for months, but, except in the earliest stages, when the diagnosis must be regarded as somewhat uncertain, no cases of permanent arrest of the disease have been recorded.

The average duration of the disease is between two and three years. In some cases it has been known to continue longer, and cases are on record in which the duration is said to have been twenty years. On the other hand, it sometimes runs an acute course, ending in death in a few months.

Etiology.—General paresis—paretic dementia, general paralysis of the insane—is a disease of the middle period of life, rarely beginning before the thirty-fifth and still more rarely after the fiftieth years of life. Cases among children or in old persons are, however, not unknown. It

attacks by preference persons in the higher walks of life, but among these is found especially in such as have more or less irregular habits. Syphilis is regarded by many authorities as the most prominent single cause, but cases frequently occur in which no evidence of syphilitic infection can be found. Mental stress, especially when associated with intemperance, venereal excesses, or other irregular habits are often found as precedent conditions and may perhaps be regarded as etiological factors.

It is more frequent in cities than in country districts. Men are attacked from three to five times as often as women. The latter appear to be becoming more subject to the disease, as a few years ago the proportion in the two sexes was stated as 1 to 7. Clergymen are almost exempt, while actors and "men about town" are the most frequent victims.

[We have seen that the ductless glands, in the light of my views, sustain the vital process and defend it. General paresis is essentially the manifestation of general collapse of these organs leading to a corresponding breaking down of the whole organism. Syphilis is an undoubted factor in many cases, Noguchi, in fact, having discovered spirochetæ in the brains of subjects who had died of the disease. But syphilis is but one of the many depressing influences which steadily weaken the functional efficiency of the ductless glands. S.]

Pathological Anatomy.—In general paresis we have a psychosis based upon recognizable structural alterations in the brain. These alterations are so disseminated that the entire brain undergoes a gradual loss of functioning power as a whole. The structural changes in the brain are found everywhere. The vascular sheaths are filled with white and red

blood-corpuscles, the vascular walls thickened, and the caliber of the vessels diminished. In the substance of the brain there is an increase of the connective-tissue elements which, we have reason to believe, produce atrophy of the brain-cells by pressure. There is also frequently close adhesion between the arachno-pia and the surface of the brain. There is pretty constantly a disappearance of medullary nerve-fibers. At times there are minute hemorrhages into the substance of the brain.

The arachno-pia is generally cloudy and thickened. The convolutions are diminished in volume and the fissures wider than normal. The cortical substance is decreased. The average diminution in weight of the brain amounts to 100 to 200 Gm. (3 to 6 ounces).

There is a widely pervading cell degeneration of a granular, probably fatty type; overgrowth of the connective-tissue structure within the cerebral substance, and a diffuse, inflammatory change around the sheaths of the blood-vessels, with slighter alterations in the sheaths themselves. It is regarded as very probable that the beginning of the disease is to be found in some alteration of the blood-supply, followed by a periarterial lymphoid growth, disturbance of the lymph-currents, consequent malnutrition of the nerve-structures. The skull is at times markedly thickened. In the medulla oblongata and the spinal cord structural alterations similar to those in the brain are found.

Prognosis.—The general experience is that general paresis is incurable. The prognosis is, therefore, unqualifiedly bad. While the prog-

ress of the disease can be interrupted by appropriate management, no method of treatment is known by which it can be permanently cured.

[The judicious use of organotherapy should modify this unfavorable prognosis. S.]

Treatment.—Obviously not much can be said about the treatment of a disease which, according to all observations, uniformly tends to a fatal ending. It is possible that an early recognition of the disease may lead to measures to arrest its progress. It must be confessed that at present our notions of such measures are extremely vague.

[In the treatment of general paralysis the misuse of organotherapy may be very harmful. Large doses of **thyroid gland** simply hasten the morbid process. Small doses, on the other hand, not more than 1 grain thrice daily, counteract it by inciting metabolism. Alone, however, it is harmful, since all other ductless glands are functionally defective. What is necessary, therefore, is to compensate for *all* the ductless glands and to give, besides the small dose of thyroid, **adrenal gland** or, better, **pituitary**, **thymus** with **ovary** or **corpora lutea** in females, or **testicular** or **orchitic** extract in males. Good food and out-of-door life, with cessation of all bad habits, will do much for these cases. In some an underlying autointoxication of intestinal origin demands the weekly use of **calomel**, and intestinal antiseptics, **salol**, **creosote carbonate**, or **menthol**. S.]

Complete **rest** from business and removal from all sources of irritation are the first objects to be striven for. **Dissipation**, intemperance and venereal excesses must be **abandoned**. **Removal** to a properly managed institution as early as practicable is, therefore, to be urged. When the patient is at liberty and in control of money or possessed of credit, his expansive delusions will often lead

him to the commission of acts which, while not dangerous, may be decidedly embarrassing to himself or others.

Antisyphilitic treatment may be of benefit even in those cases where there is no evident syphilitic taint. **Mercury** and the **iodides**, the latter in large doses, may cause arrest of the connective-tissue proliferation, and the absorption of the new formation in the brain and spinal cord. From $\frac{1}{2}$ to 1 ounce (15 to 30 Gm.) of iodide should be given daily.

[**Salvarsan** may be tried, but it has not given satisfactory results. It should not be forgotten that any preparation of arsenic depresses the functional activity of the ductless glands. S.]

To combat the sleeplessness, **chlo-ral**, **bromides**, **sulphonal**, and **paraldehyde** are indicated. In some cases, however, even excessive doses of these drugs fail to produce their beneficial effects. **Opium** may be cautiously tried, and will sometimes be effectual.

Good results have been reported from the use of **cold wet packs** with **ice-cap**, during one to three hours.

Great care is necessary in feeding advanced cases to **prevent bolting** of large morsels of food, and consequent asphyxia from entrance of food into, or compression of, the air-passages. Attendants should be instructed how to remove masses of food from the esophagus.

In the paralytic attacks attention must be paid to regularly emptying the bladder and rectum.

Cleanliness and frequent changes of position in those patients who have become bedfast from the advance of paralytic symptoms will tend to **avert bed-sores**. When these occur, the recognized surgical measures—

namely: cleanliness, bathing with dilute alcohol, and removal of pressure—are indicated.

Finally, all measures tending to make the patient more comfortable and less objectionable to his surroundings should be employed. R.

CATATONIA.—Definition.—Catatonia is a form of insanity characterized by depression, exaltation, stupor, confusion, and dementia, usually occurring in regular cyclical sequence. There is also a spastic condition of the muscles and a tendency to rhythmical movements. It is now merged with DEMENTIA PRECOX and is treated under that heading, vol. iii.

[See also in the present article under the heading of **Paranoia**, page 676, my remarks on treatment. S.]

CONSECUTIVE DEMENTIA.—Definition.—Consecutive dementia is a state of permanent and incurable weak-mindedness following an acute psychosis.

Symptoms and Course.—In 100 cases of acute mania or melancholia, from 50 to 75 per cent, will, under appropriate treatment, end in mental restoration, 10 to 12 per cent. will die of exhaustion or intercurrent somatic disease, and the remainder will run into chronic mania or melancholia or into dementia. By this term is meant an alteration in the mental functions characterized primarily by enfeeblement of the psychical processes. The subject may recover sufficiently from the acute psychosis to properly perform mechanical labor of various sorts, particularly if he is prompted by someone, but consecutive thought, especially upon a complex subject, is impossible. Such persons are sometimes spoken of as having recovered with defective action of the brain,

and many of the cases of mania discharged from hospitals as recovered are examples of such partial destruction of brain-power. He can continue doing his usual work, especially if it is mechanical and does not involve complex mental processes; but he is easily confused, is often irritable, may retain delusions or have hallucinations, and is altered in disposition in various ways. His friends will often remark that he is not the same since as before his illness, but it is often not easy to define exactly in what this alteration consists. In a more pronounced form of dementia there is great confusion of thought. Consecutive action as well as consecutive thinking becomes impossible.

The dement of this stage may wheel a barrow, dig a trench, shovel sand, break stone, or chop wood with a good deal of energy, but every little while he stops, looks vacantly around, until his attendant calls to him, or until the repetition of some associative sight or sound calls up the remembrance of what he is doing, and of the necessity for "moving on." It is often extremely interesting to watch these mental paralytics at their occupation, and to note the breaks in the continuity of their mental processes.

Among the relics in all hospitals and asylums for the insane are many in whom the fire of maniacal exaltation has burned out. They lack all consecutive mental activity. To the loss of intellectual power and volition is added the failure of motor power. The subject has become a paralytic and sits or lies in bed, or on the floor, staring vacantly, taking no notice of his surroundings, passing urine and feces unconsciously, eating everything placed before him, or put into his mouth, and

sometimes picking up and swallowing the most disgusting things.

Speech is often defective in consecutive dementia. It is slurring or lisping, and sometimes stammering, or syllables are cut off or dropped out of words. This may be due to structural change in the speech-center or defect in the conduction of efferent impulses. At times there is mnemonic aphasia.

Diagnosis.—Consecutive dementia resembles in many respects idiocy and imbecility, from which it is easily differentiated by the history. General paresis rarely offers any difficulty, as the active delusions in this disease differentiate it readily from consecutive dementia.

Prognosis.—Conservative dementia being due to structural alteration in brain-tissue, is, in the present state of knowledge, incurable. It is often not actively progressive, and the dement may live in good physical health and weakened mental power for many years. In institutions for the insane tuberculosis finds most of its victims among the subjects of dementia.

Treatment.—This is purely symptomatic. Systematic employment and careful attention to nourishment and sleep will make most dement comfortable. R.

[The line of organotherapy recommended for **General Paresis** should be tried here. S.]

SENILE DEMENTIA.—**Definition.**—Senile dementia is a chronic, progressive weak-mindedness due to structural alteration in the brain occurring in advanced life.

Symptoms and Course.—As the physical powers decay with advancing years, the intellectual functions also become imperfect. There is in some cases a gradual alteration of the character of the person.

Memory of recent occurrences is usually impaired, while the recollection of past events is sometimes very detailed, if not exact. Old stories are told and retold without remembering that they were told before. The subject becomes suspicious of his relatives and friends, is easily excited and irritated, misplaces articles and, forgetting where they were placed, accuses others of stealing them.

Among the prominent symptoms are increased sexual desire, with diminution of power to perform the sexual act. The patient not rarely makes unseemly exposure of his person, and, as if conscious of his sexual incapacity, commits indecent assaults upon young girls.

The senile dement is obstinate and vain. He will not recognize the fact that his physical and mental powers are waning, but insists that he is as capable of conducting his business and other affairs as when in the prime of life. Thus, the doctor who is the victim of beginning senile dementia believes himself more capable than ever of attending to his professional duties, and resents the imputation that he is getting too old to do his work properly.

Among the more striking physical symptoms are those associated with structural alterations in the central nervous system. There is usually a halting or lisping speech; the gait becomes slovenly or shuffling; there is loss of control over the sphincters, the urine and alvine evacuations passing into the clothing and bed unconsciously. There are also occasional slight paralytic strokes, sometimes with temporary loss of consciousness. These are, however, generally recovered from after a short time.

The sleep is usually disturbed, although in the later stages the opposite

condition a constant desire to sleep, may be present.

There is often a great tendency to stray away, requiring the patient to be constantly watched.

Senile dementia is rare before the sixtieth year. Its course is usually slow, running over several years. Striking improvement is sometimes observed, though it is rarely permanent. In the later stages when the patients are confined to bed, there are often large bed-sores, which increase the difficulty of treatment.

Diagnosis.—The history of the case is usually sufficient to prevent mistake. Some tardy cases of general paresis may be confounded with senile dementia, but a short period of observation should be sufficient to make a definite diagnosis.

Pathology.—In a large proportion of senile demented the fundamental cause consists in atheromatous degeneration of the cerebral blood-vessels and in the frequently resulting atrophy of the brain. These anatomical changes apart from those due essentially to senile decay are traceable mainly to chronic alcoholism, syphilis, gout, rheumatism, venereal excess, great and prolonged physical strain, and intense and long-continued mental application, with anxiety or worry and lack of self-control.

Prognosis.—This is unfavorable. Recovery of normal mental function never takes place.

Treatment.—The treatment is symptomatic. The patient needs constant care to keep him clean, to prevent straying off, and to avert injury likely to result from his carelessness.

When there is defective circula-

tion a mild stimulant may be useful. Sleep is best induced by malt liquor, paraldehyde, trional, or opium. Chloral should be avoided on account of its depressing effects. R.

[The treatment on organotherapeutic lines for **General Paresis** (see page 690) should be tried faithfully here. Senile decay is essentially due to deficient activity of the ductless glands. But coprostasis and other sources of autointoxication are omnipresent in the aged. This feature should also receive attention, **purgatives** and **intestinal antiseptics** being used with due supervision of the case. S.]

EPILEPTIC DEMENTIA.—**Definition.**—A form of dementia occurring in advanced stages of epilepsy, due to structural alterations in brain-tissue.

Symptoms and Course.—A large proportion of epileptics are attacked by a secondary dementia, which is usually progressive.

In the early stages there are frequent outbreaks of violence, which may be due to hallucinations or delusions. The epileptic dement is often extremely dangerous from the sudden and unprovoked character of the violent outbreaks. He is usually quarrelsome with the weak and peaceably inclined, but soon acquires a wholesome respect for those who strike back. He usually makes constant complaints, often false, of ill-usage on the part of others. Untruthfulness is so frequent among epileptic demented that it may be almost regarded as a characteristic.

In advanced cases the failure of the mental and physical powers becomes very noticeable. The speech is affected and control of the sphincters is lost. Most patients die, in *status epilepticus*, of intercurrent pneumonia, or of exhaustion.

Treatment.—All epileptic demented should be placed in appropriate institutions on account of the danger from outbreaks of violence. The usual remedies for epilepsy may delay the progress of the dementia, but no hope of arresting it can be entertained. R.

[Some cases are helped by **thyroid gland** in small doses, large doses aggravating the trouble. Bolting of food is a spasmogenic factor in these cases. Frequent **laxatives** and the use of intestinal antiseptics, **salol**, **menthol**, **creosote carbonate**, or **lactic acid bacillus** do much to reduce the number of epileptic seizures. **Saline solution rectal irrigations** are also very helpful, especially if *status epilepticus* is threatened. S.]

GROUP V. PSYCHOSES DUE TO GROSS LESION IN THE BRAIN.

Under the term *organic dementia* authors describe those forms of insanity due to destruction of areas of brain-tissue following syphilitic deposits, abscesses, hemorrhagic infarctions, tumors, aneurisms, and cranial traumatisms.

SYPHILITIC INSANITY.—**Definition.**—Insanity due to syphilitic new formation in the brain or meninges.

Symptoms.—Severe and long-continued headache, more intense usually at night, frequently precedes any psychical manifestations. Attacks of unconsciousness, sometimes convulsions and coma, are not rare. After one of these attacks there is frequently local or general paralysis, which may be transitory or permanent. Ptosis is a frequent symptom. Halting speech and actual aphasia may also occur.

Stupor and depression may alternate with maniacal outbreaks. The memory is often profoundly impaired, the patient forgetting even his own name, business, and place of

residence. In many cases the symptoms resemble so closely those of general paresis, including delusions of grandeur, that a differential diagnosis is impossible during life. In most cases, however, the motor disturbances are of a more distinctly paralytic character, complete loss of power of certain muscular groups being more frequent than in general paresis. In advanced stages the dementia is usually profound.

Diagnosis.—This must depend largely upon the history. The presence of evidences of syphilis in other organs; sudden attacks of aphasia, following apoplectic or epileptiform seizures; hemiplegia and ptosis, with the psychical symptoms above mentioned, will permit a probable diagnosis to be made in the majority of cases. As stated, however, a positive differentiation from general paresis is often impossible during life.

Pathological Anatomy.—The syphilitic neoplasm may be in the form of a diffused gummatous meningitis, endarteritis, or gummatous foci in the brain. Meningitis may also result from gummatous osteitis of the cranial bones.

[Spirochetæ have been found in the brain by Noguchi. S.]

Prognosis.—In the early stages if appropriate treatment is promptly instituted the prognosis is not unfavorable. If, however, the morbid process has advanced, and brain-tissue has been destroyed by the neoplastic infiltration, or by the endarteritic process, no hope of restoring the normal condition can be entertained.

Treatment.—**Mercurial inunction** and **potassium iodide** in large doses should be employed as soon as a

probable diagnosis is made. The iodide may be given in doses of $\frac{1}{2}$ to 1 ounce (15 to 30 Gm.) daily, pushing it to the limit of tolerance. The effects of mercury must be watched, and care taken to keep the patient's nutrition at a proper standard. Iron will generally be required. R.

[Salvarsan is, of course, indicated in these cases, especially in the presence of a confirmatory Wassermann. S.]

In paralytic cases the development of bed-sores should be carefully guarded against.

INSANITY FROM CEREBRAL TUMORS AND ABSCESES.—In many cases of brain tumor or brain abscess no psychical symptoms are present. In others, however, there is loss of memory, apathy, dullness of perception, occasionally of intellectual perversion. Hallucinations and delusions may be present. When the neoplasm encroaches upon the visual sphere, hallucinations of vision may complicate loss of sight. In one case of a large abscess in the occipital lobe there was almost entire loss of vision, with delusions of personality, probably depending upon visual hallucinations. Christian and Raymond have reported cases of hallucinations of vision apparently depending upon intercranial growths.

Treatment.—Obviously the only treatment that can be considered is palliation of the symptoms and surgical interference. R.

INSANITY FROM CRANIAL TRAUMATISM.—Insanity follows cranial injuries much more frequently than is commonly supposed. The delirium attending concussion of the brain or traumatic meningitis may be ignored here entirely as appertaining entirely to surgery. But

many of the cases recovering from the acute mental disturbances following shock and inflammation later become permanently insane.

The prevalent form of injuries, according to Gonzales, was a fall on the head. In both sexes the consequences were epilepsy, melancholia, dementia, mania, imbecility, and moral insanity. The psychical phenomena appeared in some cases a few days after the injury, and in others their first appearance varied from a few months to a few years.

It has been pointed out by Sir J. Batty Tuke and others that a condition closely resembling, if not identical with, general paresis may follow injury to the brain.

Treatment.—In cases of fracture of the skull the recognized surgical procedures are indicated. In contusion, opening of the skull at a point opposite to the site of injury will often show evidences of inflammation of the meninges and contusion of the brain. It is probable that trephining and drainage will sometimes prevent the subsequent development of insanity.

In the secondary dementias following brain injuries, operative procedures, unless demanded by focal symptoms, are not likely to be beneficial. R.

GROUP VI. PSYCHOSES DUE TO TOXIC SUBSTANCES CIRCULATING IN THE BRAIN.

In this group are brought together not only those cases in which the cause can be clearly attributed to a poison circulating in the blood,—such as alcohol, lead, and drugs (salicylic acid, opium, cocaine),—but also those which are believed to be due to autogenetic or infective toxins, such as puerperal and surgical sepsis, uremia, the toxins of

influenza, typhoid fever, pneumonia, insolation, etc.

ACUTE CONFUSIONAL INSANITY (*Acute Delirium, Acute Delirious Mania*).—**Definition.**—An acute form of mental disturbance, beginning suddenly or with few prodromes, characterized by incoherence and confusion of thought, excitement, or at times stupor, hallucinations, fever, and a tendency to exhaustion.

Symptoms.—Headache and insomnia may precede the outbreak. Usually, however, the only noticeable prodromic symptom is a state of irritability or anxiety. In most cases the patients suddenly become excited, talkative, have hallucinations or illusions, which are rarely of an agreeable character. They may see rats, snakes, spots of blood, etc. The visual hallucinations are often like those of delirium tremens. Auditory hallucinations may also be present, but are infrequent. The hallucinations and illusions are usually of a changeable and fleeting character. Sometimes there are delusions of suspicion and persecution, and occasionally delusions of grandeur. The patient soon becomes incoherent, loses all relation of time and space, does not recognize his surroundings, and confounds his own and others' personality. There may be sudden outbreaks of violence, which sometimes lead to homicidal acts, as in cases of puerperal and alcoholic insanity. The hallucinations and illusions are sometimes of an erotic character.

Temporary lucidity may occur, but is usually transitory.

Some patients are excessively loquacious, chattering senselessly all the time, making nonsensical rhymes, or repeating a great number of words having a similar sound. Thus, a remark that the patient looks bright will lead to a string

of words like: "bright, light, sight, tight, fight, night, kite," as if read from a rhyming dictionary. At times the patient makes new and often bizarre words. This is perhaps a form of amnesic aphasia. At other times there is mutism with muscular rigidity, the patient being apparently in a cataleptic condition.

Frequently there is great motor restlessness. The patient is kept in bed with difficulty, and, if allowed to get up, runs about the room or ward, shouts, laughs, pounds against doors, breaks windows and furniture, and tears his clothing. He does not control his sphincters and passes urine and feces into the bed and clothing.

There is usually fever, with rapid and, in advanced cases, feeble pulse. The tongue is dry and coated; there is loss of appetite and frequently refusal of food, although this can usually be overcome without resort to forcible feeding.

Diagnosis.—The differentiation must be made from mania and melancholia. The affection is frequently confounded with the former. Many cases pronounced mania, even by expert alienists, belong to the group of acute confusional insanities.

Etiology.—It is probably due to a toxemia in all cases. The poisonous materials may be absorbed from the intestinal canal, from wounds or septic areas, or may be formed in the blood, tissues, or glands. They may be auto-genetic or introduced from without. In some cases organisms have been found, but their specificity has not been demonstrated.

Acute confusional insanity occurs during or after infectious diseases (typhoid fever, influenza, pneumonia, rheumatism); after surgical operations,

in the puerperium, during lactation, after cranial and other traumatisms, neuritis; from the ingestion of alcohol, opium, cocaine, lead, and other drugs; from the inhalation of certain poisonous gases,—sulphide of carbon, sulphuretted hydrogen, etc. Cerebral exhaustion, fright, anger, and other psychical shocks are also said to cause this form of mental disturbance.

[As stated, confusional insanity is essentially the result of toxemia in all cases—but one in which three factors prevail: relaxation of the arterioles admitting blood to the brain *plus* the toxemia, and, in addition, overactivity of all the ductless glands concerned in the antitoxic process. S.]

Prognosis.—The prognosis of acute confusional insanity is generally favorable. While a considerable proportion die from exhaustion under the customary methods of treatment, the number passing into dementia is comparatively small. The recovery rate should be, under favorable conditions (early treatment, careful nursing), at least 75 per cent. The greatest danger is from exhaustion.

Treatment.—The tendency to exhaustion being an ever-present one in acute confusional insanity, the first and most important requisite in the treatment is **rest in bed**. Isolation is not necessary, and, in the opinion of the writer, not desirable. Patients may at times be treated successfully at home, but where an institution is accessible, the chances for recovery are better if the patient is removed to one.

[The main aim in this condition is to facilitate the elimination of the pathogenic toxics. **Calomel**, to promote the antitoxic activity of the liver, should be followed by a **saline** to eliminate all calomel from the intestinal tract. Then large, **warm, saline-solution** enemas twice daily, or **hypoder-**

moclysis are indicated to enhance renal action. S.]

Nutrition demands constant attention. **Easily digested food** in sufficient quantity must be provided, and the physician should satisfy himself that the patient gets it at the proper times. Forcible feeding is rarely necessary, but many patients require **urging to eat**. Such a one is liable to suffer in the hands of a careless nurse or attendant. **Stimulants** are often necessary, especially in cases with much fever.

The insomnia and delirium can often be overcome by **warm baths**, but if the usual hygienic means of producing sleep fail, hypnotics must be resorted to. Of these, **opium** is to be preferred, on account of its stimulant properties. Chloral, hyoscine, and paraldehyde are not recommended, the former on account of its depressant effect upon the heart, and the two latter because they interfere with nutrition. Next to opium, **sulphonal** and **trional** may be cautiously tried.

[**Chloral** and **morphine** given together are very effective. While the former tends to dilate the vessels of the splanchnic area, the latter tends to contract the cerebral arterioles, when the dose is not too small, thus relieving the brain of the hyperemia which causes the delirium. S.]

Digitalis, **strophanthus**, and **strychnine** are often of great value to tone up the depressed heart. The bowels should be kept open by mild **saline purgatives**.

Tincture of chloride of iron in large doses is often of value. Under proper management, recovery is often remarkably rapid. All **sources of toxemia** should be sought for, and if possible removed. R.

PUERPERAL INSANITY.—**Definition.**—Mental disturbance occurring in the puerperal period, due to toxemic infection. The clinical form of the disease is usually acute confusional insanity.

Symptoms and Course.—The symptoms of puerperal insanity are usually those of acute confusional insanity. The outbreak of the disease usually occurs in the first week of the lying-in period. It is in almost all, if not in all, cases related to certain well-known symptoms of puerperal sepsis. Fever is nearly always present. Changes in the quantity and character of the lochia are frequent. There may be prodromic symptoms, although usually these are not well marked. This consists either of depression, irritability, or emotional instability. The outbreak usually begins with excitement, rapidly ending in incoherence. The usual feelings are perverted. The patient may have attacks of violence during which attempts are made on the life of the husband, the newly born child, or other children, if there are any. These attempts often have a religious basis; at other times they are based upon delusions of jealousy.

Not infrequently the hallucinations and delusions of the patient are of a sexual character. The most refined women will surpass the imagination of the veriest rake and gutter-snipe in their obscenity and vulgarity of language and action.

Motor excitement is common. There is frequently a tendency to remove the clothing. In some this appears to be a desire to expose the body to view; in others it probably is due to an hallucination of common sensation, rendering the weight or pressure of the clothing unbearable.

A second stage following this excitement is often one of depression. The distinction from true melancholia is, however, easy. The patient gets apathetic, there may be depressive delusions, suicidal tendencies may develop, and there may be alternations of excitement and depression, with incoherence as a dominant symptom, lasting for years. While cases end not infrequently in secondary dementia, this is not frequent. The writer has seen an apparently complete recovery from puerperal insanity after six years' residence in an asylum.

The superpose stage of confusional insanity is usually passed through by puerperal cases on the way to recovery or dementia.

Etiology.—As stated in the definition, the writer believes puerperal insanity to be due to toxemic infection. The reasons for this opinion are the following:—

1. Puerperal insanity occurs, in the great majority of cases, within the first ten days after delivery—about one-half in the first five days—the same period during which puerperal infection usually occurs.

2. It is usually accompanied by elevation of temperature and other evidences of febrile disturbance.

3. The clinical form in which puerperal insanity manifests itself is, in the majority of cases, that of acute, delirious, or confusional mania. Depressive states are rare except as secondary forms. In other words, the most frequent condition is one most closely resembling febrile delirium.

4. The death rate is much higher than in simple mania. Death occurs from exhaustion, usually with high temperature and rapid pulse.

5. Post-mortem examinations, though,

apparently infrequent in these cases, have shown grave involvement of the pelvic viscera.

6. Examinations of the pelvic organs during life show lacerations of the perineum and cervix uteri (facile channels of infection in the puerperal woman). As secondary conditions are found intrapelvic (peritoneal) inflammations, and consequent abnormal locations, fixations, and congestions of the uterus, tubes, and ovaries.

[That a toxemia is the underlying cause of puerperal insanity in most instances is now generally accepted. An underlying cause of the toxemia is the exhaustion of the ductless glands, which are under stress during pregnancy, and the resulting deficient antitoxic power of the body fluids. S.]

Prognosis.—The prognosis of puerperal insanity is favorable: 75 to 80 per cent. recover, but a large proportion of the remainder die of exhaustion. According to Wideroe, the prognosis is better for primiparæ than for women who have previously had children, and more favorable the younger the patient.

Treatment.—The principles of treatment indicated under acute confusional insanity are in place here. **Bed-rest, good food, and hypnotics** when necessary are the indicated remedies.

[The additional measures I recommended for acute confusional insanity are also indicated here. But in the present connection **thyroid gland** in small doses is often useful to facilitate destruction of the pathogenic poisons. S.]

Bearing in mind that puerperal insanity is an infection psychosis, the local **sources of infection** should be **sought** out and removed if possible. In some cases there is simply **sapremia** due to absorption of septic materials from the birth-canal. Here

the use of **vaginal douches of hot water**, medicated with antiseptics or not, are in order. In cases of purulent endometritis **curettage** of the interior of the uterus with repeated irrigation or **gauze packing** will be required. In cases where tubal, para- or peri-metric inflammatory disturbances have occurred, the proper procedure has always seemed to the writer to be the operative **removal of the foci of infection**. Even in cases of long standing (two to five years) the operative removal of local sources of irritation and infection has resulted in entire cure of the mental disturbance. R.

LACTATIONAL INSANITY.—

Definition.—Mental disturbance occurring during the period of lactation, usually coming on from six weeks to ten months after labor. Prevailing types: **confusional insanity** and **melancholia**.

Symptoms.—In the depressed cases all the phenomena of melancholia are usually present. Frequently there is simple depression without hallucinations or delusions. Suicidal tendencies are frequent.

The cases usually described as maniacal belong, in the majority of instances, to the acute confusional type. There are varying hallucinations and delusions, incoherence, refusal of food, generally fever, want of control of the sphincters, and a tendency to exhaustion.

Etiology.—Prolonged or excessive lactation is given as the chief cause of insanity occurring during the nursing period. Careful inquiry will, however, show that certain conditions favoring toxic infection are often present. Thus, a mammitis or mammary abscess not rarely pre-

cedes the mental disturbance. Defective uterine involution is regarded by Bevan Lewis as a factor. The writer has found lacerated cervix and endometritis present in some cases.

The occurrence of confusional insanity during the nursing period is the only diagnostic feature. There is nothing distinctive in the symptomatology. Between 3 and 4 per cent. of all cases of insanity in women occur during the nursing period.

Prognosis.—Moderately favorable. From 40 to 50 per cent. recover. Clouston claims as high a proportion as 77 per cent.

Treatment.—Removal of local sources of infection or irritation. Good food and hematic tonics are usually indicated. Arrest the drain upon the vital power by stopping nursing. R.

[Here, again, the measures recommended for the acute confusional type are indicated. **Thyroid** in small doses, besides enhancing the antitoxic activity of the blood, tends to arrest the formation of milk. S.]

SATURNINE INSANITY.—**Definition.**—Insanity following the absorption of lead.

Symptoms and Cause.—Two forms of insanity from lead are described. In the one the patient is incoherent, but not very much disturbed. In the other there is violent, noisy behavior with incoherence, followed by deep sleep or coma. Tremor and subsultus tendinum are usually present. At times there are epileptiform convulsions. The usual objective signs of lead poisoning are present.

Prognosis and Treatment.—The disease is extremely grave. About one-fourth of the cases die in the attack. Dementia may follow in cases

escaping death. The majority of cases recover with or without mental defect. The treatment is that of lead poisoning with potassium iodide as sheet anchor. R.

UREMIC INSANITY.—**Definition.**—Insanity occurring in the course of Bright's disease and due to the non-elimination of toxic materials from the blood.

Symptoms.—It has been shown statistically that a large proportion of the insane in hospitals and asylums in this country have chronic renal disease. Irrespective of the general etiological significance of this fact is the occurrence of cases of insanity in the course of chronic Bright's disease and probably depending upon the same causative factors as other symptoms of uremia.

Systematic examination of the urine should be part of the routine in all examinations of insane persons.

Treatment.—In addition to the usual remedies for the uremic condition, **morphine** is often necessary to quiet restlessness and delirium. R.

[A salt-free diet, small doses of **thyroid gland**, watching the urine closely, **Vichy** and **milk** as beverage, with **avoidance of meats and eggs**, give good results in a large proportion of cases. S.]

POSTFEBRILE INSANITY.—**Definition.**—Insanity arising in the course of or following infectious diseases.

The ordinary febrile delirium is not included here, although probably depending upon the same essential cause: *i.e.*, a toxemia.

Insanity has been observed during the course of or following typhoid, typhus, and malarial fevers, small-pox, measles, erysipelas, rheumatism, gout, cholera, and influenza. The



Purpura Hemorrhagica.

St. Louis Hospital Paris.

last-named disease has preceded insanity in a large percentage of cases occurring within the past nine years.

[It is important to distinguish between the ordinary *febrile* delirium which is due in part to excessive (defensive) activity of the ductless glands during *febrile* infections, and the *postfebrile* type, which occurs when the same glands have become exhausted by the febrile process. The first is simulated by the delirium of Graves's disease, and the second by that of myxedema, two opposite conditions. S.]

Symptoms.—The clinical forms of mental disturbance described as following febrile diseases may be confusional insanity, melancholia, and mania. Purely exalted conditions seldom occur. When there is melancholia, it is usually associated with hallucinations and delusions. The hallucinations and delusions of the acute stage often persist in the stage of dementia.

Incoherence with hallucinations, illusions, and delusions are usually marked symptoms of postfebrile insanity. In heavy drinkers a violent maniacal delirium sometimes occurs during the height of the febrile process.

Two cases complicating pneumonia have come under my notice. Clouston has laid especial stress upon the mental depression succeeding influenza.

Prognosis.—This is usually favorable. If the patient escapes the dangers of exhaustion in the acute stage, recovery takes place in from 70 to 80 per cent.

Treatment.—The treatment of postfebrile insanity usually requires careful attention to the nutritive functions. **Tonics** and **stimulants** are nearly always indicated. When hypnotics are necessary, the **depressive**

drugs—chloral, bromides, sulphonal—should be **avoided**. **Opium** and **cannabis indica** are often of great value.

[In postfebrile insanity, organotherapy, particularly **adrenal**, **thyroid**, and **thymus**, given jointly prove very efficient in conjunction with the usual tonics, particularly **strychnine**. S.]

POSTOPERATIVE INSANITY.

—**Definition.**—Insanity following, immediately or remotely, operations upon the body.

Symptoms.—There can be little doubt that in persons with emotional instability the shock of a grave operation may produce transitory delirium, or even more persistent mental aberration. The frequency of the so-called "transitory mania" at the moment of the completion of the second stage of labor is evidence that intense pain, combined with high nervous tension, is capable of producing it. The delirium attending severe injuries—"traumatic delirium"—may also in most cases perhaps be ranged with the cases of mental aberration from shock. Those cases of postoperative delirium or psychosis following immediately after the operation may be classed in this category. That other factors may concur in the production of this form of psychosis—*e.g.*, anxiety, worry, and the like—is probable. Ahlfeld reported a case of violent mania following the introduction of a speculum, and Kiernan, one consequent on the passage of a catheter in a man. In the small number of reported cases no other essential factor than the shock and anxiety can be traced. From this form the patient usually recovers.

A second class of postoperative insanity would appear to be due to the absorption of poisonous agents used before, during, or after the operation.

It is now generally accepted that the acute mental disturbances, mostly hallucinatory in character, following operations upon the eye are due to the use of atropine and similar drugs. It is not improbable that some of the post-febrile psychoses are attributable to a similar cause.

These cases of drug poisoning with pronounced symptoms of mental disturbances are probably not so very rare as sequelæ of grave surgical operations, particularly where extensive use is made of chemical antiseptics during the operation or in the after-treatment. The excessive use of opium, quinine, and other anodynes and antipyretics may with good reason be charged with some of the cases of postoperative insanity. The rare cases of mental disturbance following the administration of anesthetics may properly be ranged under the same heading.

A third class of cases of postoperative insanity is probably due to the absorption of septic materials from the wound or surface exposed during the operation. The insanity in most instances develops several days after the operation, and is usually of the clinical variety termed "acute confusional insanity." The prominent symptoms are: insomnia, restlessness, emotional instability; sometimes sudden, violent outbreaks, followed by incoherence, variable hallucinations,—especially of vision,—and sometimes delusions of grandeur or persecution. In most cases there are symptoms of fever, and usually marked implication of the physical powers. The pulse is rapid and weak, the temperature elevated, the tongue dry and red, and there is, usually, refusal of food. Exhaustion of mind and body rapidly intervenes, and the patient sinks into a state of

muttering delirium, coupled with great bodily weakness.

Le Dentu says that the mental disturbance begins from the second to the fifth day, although in some cases not until the twentieth or even later.

Excluding the cases due to shock, nervous strain, exhaustion, and drug-intoxication, which generally appear within the first twenty-four hours, it is probable that the majority, if not all, of the cases of postoperative insanity coming on within the first week are septic in origin. Puerperal insanity is now generally regarded as essentially a septic psychosis, and in this large and well-studied class of mental disturbances we have the closest analogy to most cases of postoperative insanity.

Prognosis.—The prognosis of postoperative insanity is that of confusional insanity generally; *i.e.*, while the death rate from exhaustion is large, amounting to 12 or 15 per cent., the recovery rate of the remainder is also large. The cases that terminate in secondary dementia probably do not exceed 10 per cent.

The tardy cases of postoperative insanity so called—those that come on in women from six weeks to three or four months after removal of the uterus or appendages—give a less favorable prognosis. The recovery rate in these cases is not over 50 per cent.: about the same as that of undoubted climacteric insanity.

Treatment.—In the developed psychosis the treatment heretofore recommended for confusional insanity is indicated. Much may doubtless be done in the way of prophylaxis. Strict aseptic precautions during operation, removal of all sources of irritation, both physical and psychical, in persons of neuropathic constitution requiring

operation, and careful attention to nutrition in those broken down in health from long-continued, painful, or exhausting disease, will tend to diminish the number of cases of insanity following surgical operations. R.

[Crile's **anoci association** treatment, to prevent unconscious pain during operations under anesthesia, is calculated to prevent this condition. The additional measures I recommended for confusional insanity (see page 697) are also indicated here. S.]

INSOLATIONAL INSANITY.—

Definition.—Insanity following insolation, or sunstroke.

Symptoms.—After recovery from an attack of sunstroke many persons suffer from certain indefinable changes in their character. They are more irritable, easily exhausted, especially in hot weather, and are liable to vertigo and other neurotic troubles. In a small percentage of cases insanity follows. This was already noted by Benjamin Rush, who reports 2 cases of madness caused by insolation.

The form in which insolational insanity occurs may be maniacal or depressive. In the former there may be sexual excitement with delusions of grandeur and untidy habits. The depressive form is usually attended by suicidal tendencies, delusion of persecution, anxiety, and hallucinations of sight and hearing. In some cases defective memory is the most notable psychical symptom. This may be accompanied by motor disturbances simulating general paresis.

Most writers who discuss insolational insanity class it with the traumatic insanities, assuming the evidences of meningeal inflammation, sometimes found, to be the causes of the mental disturbance. It seems to the writer, however, that the condition of the blood

and vessels found *post mortem* in cases dying of sunstroke indicate such a profound change as can only be attributed to the action of a toxin. So it has seemed preferable to group the insolational psychoses with those due to toxemia.

[We are dealing here with pseudoparesis of the cerebral arterioles plus the toxemia referred to. S.]

Prognosis.—Complete restoration of mental function is rare. A modified recovery, a partial dementia, is not infrequent.

Treatment.—This is purely symptomatic. Persons who have once suffered sunstroke should **avoid exposure in the sun** during hot weather.

[The treatment of confusional insanity with the measures I have recommended (see page 697) are also indicated here. Additional suggestion will be found in the article on **HEAT EXHAUSTION** in vol. v. S.]

GROUP VII. PSYCHOSES DUE TO DEVELOPMENTAL CHANGES IN THE BRAIN.

PUBESCENT INSANITY, which belongs to this group, has been given a separate article. See **DEMENTIA PRECOX**, in the third volume, owing to its recognized importance as the initial disease in 25 per cent. of asylum inmates.

CLIMACTERIC INSANITY.—

Definition.—Insanity occurring during the period of sexual involution in women.

Among the more serious accompaniments of the menopause is mental disorder. Statistics show that insanity in women is especially frequent between the ages of 40 and 50 years. As this is also the ordinary period of cessation of the menses, the conclusion seems reasonable that some relation exists between the two conditions.

Symptoms.—Any of the clinical varieties of mental disorder may be

present during the climacteric; but melancholia is most frequent. Melancholia is present in 66 per cent. of the cases. According to Bevan Lewis, at the early evolution of climacteric insanity, painful mental states invariably prevail, and in the large majority of cases mental depression exists throughout the attack.

Hallucinations of hearing and of smell are frequent. Religious delusions color most cases. The class of cases termed by Savage "unpardonable sinners" are especially frequent among women who become insane during the climacteric.

The fear of death, immediately impending or more or less remote, is often present. Frequently the memory and judgment are but little impaired, but the patients complain loudly of confusion of thought, fear they will become insane, will never recover, etc.

Delusions and hallucinations referable to the sexual sphere are common. Most cases of pseudocyesis occur during the climacteric. Fear of grave disease of the pelvic organs is often present. The subjective sensations of itching and burning in the external organs and the presence of leucorrhea are probably the causes of this morbid fear. Actual disease of the sexual organs is, however, often present, and all cases should be thoroughly examined to determine this point. The great frequency of uterine cancer at this period of life must not be overlooked.

Delusions referred to the digestive organs are also present, although not characteristic. Delusions of grandeur are sometimes present in the maniacal and paranoiac cases.

Suicidal tendencies are frequent, although usually not so persistent as in melancholia generally. The apprehension of death by fire is frequent.

In some cases the depression and mental anxiety lead to the use of alcoholic stimulants, resulting often in confirmed intemperance.

While there is no specific form of mental disorder that can be properly termed "climacteric insanity," there can be no doubt that the menopause must be considered as one of the exciting causes of mental disease.

[The relationship between the ductless glands and the defensive processes of the body explain this condition. As in so many psychoses we are dealing with a toxemia, but one due to reduction of one of the participants in the protectional process. The ovaries having ceased to functionate, they no longer add periodically the unused constituents of their internal secretion to the general body asset, and being composed (as biochemical tests show) of nucleins and locally formed chromaffin substance (similar to adrenal secretion), general metabolism and the antitoxic properties of the body fluids are slowed in consequence. There is, therefore, besides accumulation of toxics, vasodilation of the arterioles, governed by the sympathetic system. Hence the cerebral hyperemia and the organic changes resulting therefrom if this congestion and the toxemia are allowed to proceed. S.]

Some writers devote much attention to the consideration of a climacteric insanity in the male sex, but there is no period in the life of man that corresponds with the menopause in women.

Prognosis.—The prognosis of the insanities of the menopause is, according to authors, rather favorable, the proportion of recoveries being about 50 per cent.

Death is rare as an immediate consequence of the psychical derangement. Suicide and marasmus in those cases refusing food form the largest contingent of death in the acute condition. In chronic cases, tuberculosis claims the largest share in the death rate.

Treatment.—The treatment of the mental disturbances of the menopause often tests severely the patience as well as the therapeutic resources of the practitioner. Refusal of food often depends upon delusions, but at times disorders of the *primæ viæ* are responsible. In the latter case **lavage**, **laxatives**, and intestinal tonics such as **nux vomica** and **physostigma** are indicated. Where the reluctance to take food or its absolute refusal depends upon delusions that the food is poisoned or that the viscera are decayed, **forcible feeding** must generally be resorted to. In cases of aggravated gastric catarrh the subcutaneous infusion of a nutritive saline solution or **hypodermoclysis** heretofore recommended will often be beneficial. After a few days' rest the stomach will take up its functions with renewed vigor.

The precordial anxiety and palpitation of the heart, if troublesome, will generally yield to moderate doses of **Hoffman's anodyne**. For insomnia, **paraldehyde** is probably the least harmful hypnotic to use, although, where its odor and taste are objectionable and there is no cardiac weakness, **trional** may be substituted.

The physical depression needs **good food**, **fresh air**, and **tonics**. In states of great weakness absolute **confinement to the bed** is necessary to prevent exhaustion.

Symptoms referable to the sexual organs are not always evidence of delusion, and should not be so declared until a careful physical examination shows absence of local disease.

Mental depression is best combated by cheerful surroundings, **outdoor life**, and medicinally by **opium**. This drug should be given systematically,

as recommended in melancholia. **Cannabis indica** and **belladonna** are also at times useful. Cocaine has been recommended, but is dangerous on account of the tendency to establish a habit.

The good effects of **thyroid gland** reported, especially in melancholia, encourages to further trial with it.

The depressive hypnotics and sedatives—such as chloral, bromides, sulphonal, antipyrin, etc.—should generally be avoided in depressive mental states. R.

[This condition being due to deprivation of the autonomic secretion of the ovaries, **ovarian gland** and **corpora lutea** are indicated. Small doses of **thyroid gland** should be given simultaneously to sensitize the toxic wastes and facilitate their hydrolysis and elimination.

A careful study of each case is necessary to determine whether the toxemia is not due to other factors. The slowing of metabolism which occurs at the menopause tends to depress muscular activity, especially that of the gastrointestinal musculature. Gastropsis and enteropsosis are possibilities to bear in mind. Their correction if present, in addition to organotherapy, is soon followed by excellent results. S.]

Psychasthenia is treated under SUGGESTION THERAPY, in the eighth volume.

C. E. DE M. SAJOUS,
Philadelphia.

PSYCHOTHERAPY. See SUGGESTION THERAPY.

PTERYGIUM. See CONJUNCTIVA, DISEASES OF.

PTOMAIN POISONING. See TOXIC FOODS.

PTYALISM. See SALIVARY GLAND, DISEASES OF.

PUERPERAL CONVULSIONS. See PUERPERAL ECLAMPSIA.

PUERPERAL ECLAMPSIA (Puerperal Convulsions).—DEFINITION.—Eclampsia is a symptomatic disorder characterized by convulsive or epileptiform seizures that suddenly come on prior to, during, or after labor.

Zweifel reports a case occurring in the third month, but it is generally met with during the second half of pregnancy, and rises in frequency the nearer term is approached. While toxemia manifests itself in some form more frequently, actual eclampsia occurs about once in one hundred pregnancies, and about in the following order: during the latter months of gestation, 55 per cent.; during labor, 30 per cent., and least frequently after delivery, or, during the puerperal period proper, 15 per cent.

SYMPTOMS.—Convulsions may in rare instances appear without warning, but usually symptoms of a pre-eclamptic toxemia may be observed. Olshausen has frequently found severe epigastric pain to precede an attack and lays particular stress upon the sign. Cephalalgia and dimness of vision are commonly noted; edema of the face and occasionally insomnia are persistent signs. The prodromal symptoms occur about in the following order: vertigo, tinnitus aurium, persistent headache, precordial distress, epigastric pains, disturbed vision with total blindness, in some instances, and only blurred vision, or spots before the eyes, in others; general edema.

Systematic examination of the urine not alone for albumin and casts, but also for urea, and a record of the amount of urine passed in the twenty-four hours is obligatory even in those cases in which, although there never

has been a suspicion of renal impairment, the kidneys are nevertheless functionally impaired. *Pari passu* with diminished excretion of urea the risk of toxemia increases, and the most dangerous form of eclampsia—that which develops suddenly, without much premonition and passes into coma and death—frequently depends on urinary insufficiency as regards excretion.

Albumin and casts may or may not be present in the urine, according to whether a nephritis complicates the pregnancy or not. Should the premonitory symptoms be aggravated elimination of urea is defective, as shown by the recognized tests. Insufficiency on the part of the kidneys may be determined by measuring the amount of urine passed in the twenty-four hours and estimating the amount of urea excreted. While albumin and casts are pretty constantly present, they are not necessarily so, as a small percentage of eclampsias occur in the absence of both, so that while frequent urinalyses are essential, the keynote to the situation is the premonitory subjective symptoms, already referred to, the decreased percentage of urea excreted and the persistently high blood-pressure. The persistent systolic pressure of 160 mm. or more should always be regarded as a danger signal. Vascular tension and blood-pressure are apt to be increased except in women of an anemic type; edema, as a rule, accompanies organic renal disease.

The Eclamptic Seizure.—This is characteristic. The wide-open eyes, fixed in vacant stare, soon beginning to roll from side to side; the usually dilated pupils, the rapidly opening and closing lids, twitchings at the

nasal alæ; the clonic convulsions accompany, ordinarily, the first seizures. The convulsive movements first appear about the mouth, then extend rapidly to the arms, body, and finally to the legs. The heart's action becomes irregular, the face is cyanosed, the breathing stertorous; the patient foams at the mouth and frequently bites her tongue. Soon the convulsions become tonic in character; the eyes are fixed; opisthotonos may occur.

When the disorder appears during the latter part of labor or in the puerperium, there may be but a single convulsion. The first, however, is usually followed by others.

The number of seizures is variable, from 1 or 2 in mild cases to as many as 125 in the twenty-four hours having been noted in the more severe forms. The duration of the seizures is from a few seconds to two minutes, and the convulsions are always followed by unconsciousness, in some instances the patient not even remembering the attack itself; or else the first seizure merges into coma and ends in death. In rare instances coma may follow a single convulsion from which the patient never emerges; however, death usually occurs only after frequent repetition of the convulsive attacks. Generally, after delivery of the fetus the convulsions cease. Though eclampsia does not frequently develop after delivery, it has, however, been observed in one-third of their cases by Newell and McPherson and to the extent of 23 per cent. by Williams. In these cases the attacks usually follow each other rapidly and frequently terminate fatally.

Marked mental derangement was

observed by Löhlein and Lichtenstein in a number of instances to follow eclampsia. Hemianopsia may appear as a result of the incident cerebral lesions. Visual disturbances, due to albuminuric retinitis, may also be present or may appear as a manifestation of the general toxemia, prompt recovery usually ensuing in the latter cases.

Marked jaundice has occasionally been observed either during or shortly after convulsive seizures and is considered of grave prognostic significance, indicating serious hepatic involvement.

Nature frequently teaches us the line of action—spontaneous abortion occurring and the eclampsia ceasing.

Labor does not always occur in ante-partum eclampsia; the woman may recover and afterward give birth to a dead or macerated fetus, or carry a living child to full term.

During the eclamptic seizures the urine usually shows signs of renal insufficiency, being diminished in quantity and frequently almost entirely suppressed. Various types of casts may be observed microscopically in great abundance, the hyaline and granular varieties predominating. Epithelial casts may also be found, as well as isolated renal cells, while blood is nearly always present. Hemoglobinuria may also occur.

Albuminuria is pronounced and almost constantly present. The high albumin output is only temporary, however, falling within thirty-six or forty-eight hours after delivery, and then rapidly disappearing, though some cases may show traces for weeks. That high-grade albuminuria does not necessarily indicate profound renal lesions, may be gathered

by the fact that in several cases which have come to autopsy only a mild degenerative nephritis has been observed.

The total nitrogen of the urine is markedly diminished in eclampsia, and there occurs at the same time a great alteration in the properties of its various constituents. The urea is greatly reduced and there is a relative increase in the amount of the amino-acids, creatinin, uric acid, etc.

During convalescence the urine usually returns to a normal condition.

During the seizure there is usually an increase in arterial pressure, with a full and bounding pulse, which, however, is weaker and more rapid in the more severe cases, and becoming more compressible and filiform with each succeeding convulsion. The temperature usually remains normal, but may rise considerably from the onset of the attack, falling rapidly as improvement takes place.

Cases are occasionally met with in which the convulsions are absent, the patients dying in coma, autopsy showing the characteristic hepatic and renal lesions.

The victims of nephritis who become pregnant rarely go to term, but abort a dead fetus, the result of interstitial alterations in the placenta, or else require therapeutic abortion.

Eclampsia, as observed by Maygrier, may also occur in false labor accompanying extra-uterine gestation, or is associated with hydatidiform mole, as witnessed by Falk and Sitzenfrey, which would indicate that the metabolic processes of the fetus are not etiological factors in eclampsia.

DIAGNOSIS.—Eclampsia is usually easily recognized, but may be

confounded with acute strychnine, phosphorus, or nitrobenzol poisoning. Such instances are rare, however, and the possibility of error may be prevented by a careful history of the case. Uremia, epilepsy, acute yellow atrophy of the liver, and even hysteria, may simulate eclampsia and must be borne in mind and excluded before a positive diagnosis is made.

ETIOLOGY AND PATHOGENESIS.—The eclamptic attacks have been ascribed to various morbid conditions among which stand out prominently: the entrance of fetal or placental elements into the maternal circulation; poisoning by substances formed or retained in the placenta; an anaphylactic reaction; a toxemia of mammary origin and toxics derived from maternal or fetal metabolism. The bulk of evidence tends to favor the latter view, *i.e.*, that the spasmogenic poisons are of both maternal and fetal origin, probably of metabolic origin. The exact toxic agent, however, has not been isolated. While no one toxic agent exists in sufficient quantities to produce the convulsions, a specific ferment does exist in sufficient quantities to disturb the metabolic equilibrium, as shown by the Abderhalden reactions. There also coexists hepatic insufficiency, renal insufficiency, skin inactivity, etc., with resultant accumulations of toxins and inefficient elimination.

PROGNOSIS.—The prognosis is always serious, the maternal mortality varying from 20 to 25 per cent., and that of the fetus from 33 to 50 per cent.; Stroganoff, however, reported a maternal mortality of only 6.6 per cent. in a series of 400 cases, but this is exceptional.

[In a series of 100 cases the author had no deaths in the first 45, mostly private cases, and 6 deaths in the remaining 55 cases, including hospital emergencies, 3 of whom had previously existing nephritis—a mortality, all told, of 6 per cent.]

The condition of the pulse and temperature is of considerable prognostic value. A fair quality of pulse between attacks would indicate a favorable outlook, while if weak, rapid, and thready, a fatal issue may be looked for, especially if combined with a high temperature. High arterial pressure, if persistent, is also of serious import, even when there is improvement of the other symptoms. Complete anuria and inability to sweat in a hot pack is of ominous import. Apoplexy, paralysis, and edema of the lungs are all serious complications and usually lead to a fatal issue. The death of the fetus favorably influences the prognosis in intrapartum eclampsia, the convulsions usually ceasing soon afterward.

In 52,328 cases of labor occurring within a period of two years studied by Löhlein, there were 325 convulsions. The mortality was 19.38 per cent. Among 248 patients who survived the attacks, 54 subsequently developed other conditions; in 13 there were psychoses, generally ending in recovery; in 5 pneumonia, 3 pleurisy, and in 22 kidney trouble persisted. In 71.1 per cent. operative interference became necessary, including 108 forceps deliveries, 19 versions, 13 operations to lessen the size of the child, 2 induced abortions, and 7 Cæsarean sections.

TREATMENT.—The treatment of eclampsia may be considered to advantage under the following head-

ings: (1) prophylactic; (2) medicinal; (3) surgical.

Prophylactic Treatment.—The preventive measures, during pregnancy, are of paramount importance. If the normal metabolic process is to be maintained, strict attention must be given to the various hygienic measures, including elimination through the various channels—not diuretics for already overtaxed kidneys, but dilution of the urine by the **free use of water**, which is also intended to render the urine less irritating to the renal filter. Rest for the kidneys and elimination through other channels should be the rule. With this end in view, every pregnant woman should place herself in the hands of a physician, or, if unable to do so, visit regularly a hospital dispensary, for observation and treatment. By the institution and carrying out of the proper hygienic measures, but few toxic and non-toxic patients, in the absence of organic kidney or liver disease, develop eclampsia.

The principal **hygienic measures** consist of keeping active the sudoriparous glands by **regular bathing**—the tepid bath in the morning or the hot bath in the evening—and by **regular moderate exercise** daily in the **open air**,—preferably walking or carriage riding. The **diet** should be largely fruit and vegetable, with restrictions of nitrogenous food, especially in the later months, and liquid diet only, consisting largely of alkalized milk, if albumin appears in the urine, or any toxic symptoms develop. The bowels should be kept active with the **fruit diet** and one of the **laxative mineral waters**, alternated with **sodium phosphate**.

It is not sufficient to examine the

urine occasionally or regularly for albumin, but, in addition, to note carefully the presence of any of the subjective premonitory symptoms, previously referred to, and, in the event of their existence, have a specimen of urine submitted for analysis immediately, which analysis shall include the test for albumin and casts, the quantitative test for urea and the amount excreted. An analysis of the urine today may indicate a normal condition and tomorrow the patient may have convulsions, although this is the exception and not the rule. The blood-pressure should be taken at regular intervals.

Hyperacidity of the secretions is frequently present in the early months as well as the later months of pregnancy, and often becomes intensified prior to the development of the prodromal symptoms of eclampsia, as noted by highly acid urine and acid gastric eructations. This condition of acidosis is the result of faulty metabolism with coexisting hepatic insufficiency, and calls for alkalinizing of the secretions with some remedy or remedies that will not only overcome the acidity, but stimulate the hepatic functions also; *i.e.*, **sodium bicarbonate** and extract of **rhubarb**, combined with very small doses of **nux vomica**, given preferably before meals.

Where, notwithstanding these measures, the evidences of organic kidney disease become intensified, or where, these evidences lacking, the symptoms suggestive of impending eclampsia develop, time for action has come, justifiable delay having reached its limit. In the past and even today expectancy has been and is too often the cause of untoward results.

With the exception of the fulminating type of eclampsia—where art almost always fails, it may be stated that prompt action, of the nature to be described, will, in the vast proportion of cases, prevent the development of eclampsia.

Medicinal Treatment.—In the presence of the prodromal symptoms of eclampsia, rigid adherence to the various **hygienic measures**, especially the **diet**, elimination, and alkalinizing the secretions, are of paramount importance. When urinary insufficiency exists, active diuretics are contraindicated, while the **taking of large amounts of water by the mouth** is valuable to dilute the urine and render it less irritating to the functionally, if not organically, crippled kidneys. The kidneys may be still further flushed and the secretions alkalinized with the **alkaline-saline solution by enteroclysis**; **sodium carbonate** ʒij (8 Gm.), **sodium chloride** ʒj (4 Gm.), to the pint (500 c.c.) of water, given by the Murphy drop method; or, the same preparation may be administered once or twice daily as a colonic irrigation.

Grandin suggests that the **ingestion of large amounts of water by mouth** and repeated introduction of warm **normal saline solution** into the bloodstream will accomplish more than any and all drugs together. **Venesection**, carried to the point of tolerance, and then followed by the subcutaneous injection of a **normal salt solution**, has also been recommended. This method need not be confined to the plethoric, but even a weak pulse and profound coma do not contraindicate its use, for the rapid introduction of the warm salt solution following venesection counteracts the

effects of bleeding, filling the vessels and stimulating the heart.

The **serum treatment** is still on trial. While it has proven of value in a certain percentage of early toxemias, the results have been disappointing both during the pre-eclamptic state and for the attack. This treatment consists of the introduction subcutaneously of 8 or 10 c.c. of blood-serum, taken from a Wassermann tested pregnant woman at or near term or during labor. The serum may likewise be made from healthy placental tissue.

The Sloane Maternity Hospital report of the last 15,774 cases showed the eclampsia mortality reduced to 14.5 per cent. for the mother although the treatment was conservative.

The routine Sloane treatment is as follows: The patient is isolated in a **darkened room**, given $\frac{1}{4}$ of a grain of **morphine** sulphate, 2 ounces of castor oil following **gastric lavage**, and a **colonic irrigation** of 5 gallons of a 5 per cent. **glucose solution**, **Phlebotomy** is done if the blood-pressure is over 175 systolic until this is reduced to 150. Then $\frac{1}{4}$ grain of **morphine** is administered every hour until respirations drop to 8 per minute. By the time the convulsions have ceased the patients are in labor and are delivered normally or by easy low forceps. R. McPherson (Amer. Jour. of Obstet., lxxvii, 58, 1918).

The use of **thyroid gland** has been advocated by Nicholson, who advises that 70 to 80 grains (4.6 to 5.4 Gm.) be given daily during attacks. It has also been used by others, however, with less favorable results.

The **saline irrigation**—if a number of quarts are used at a time—promotes diuresis and diaphoresis and indirectly enforces intestinal peristalsis, and such irrigation should become the established custom not

alone in face of impending eclampsia, but also in the presence of eclampsia. Where the pulse is full and bounding and the blood-pressure remains persistently high, **venesection** is justifiable in exceptional instances, while the toxemia is being treated with the **alkaline-saline solution**, providing that, if before delivery, the alkaline-saline solution be given intravenously and simultaneously with venesection, otherwise there is danger of death of the fetus, on account of the slow current of blood-circulation in the sinuses between mother and child. I have knowledge of a few instances where the fetal heart was distinctly heard just prior to the extraction of a pint (500 c.c.) of blood, and ceased almost immediately afterward. This accident can be avoided by the simultaneous intravenous injection. The weak pulse is not necessarily a contraindication for venesection after delivery. Excellent results have been obtained by Williams in cases where the pulse was thin and weak, tending to show that venesection is indicated in all cases in which the convulsions do not cease after delivery of the child, regardless of the condition of the pulse.

Venesection.—Notwithstanding the teachings of Stroganoff and the practice of some others, viz., venesection before delivery, together with the alkaline-saline solution by enteroclysis, etc., when the pulse is full and the blood-pressure high, the author advises limiting venesection before delivery to the exceptional cases, for reasons previously stated. Furthermore, if the blood-pressure remains persistently high under eliminative treatment, and the symptoms are sufficiently grave to war-

rant venesection, they are sufficiently grave to warrant looking toward the termination of pregnancy, by rupturing the membranes—one of the best methods to reduce blood-pressure, according to Hirst—which establishes labor later; or the introduction of a medium-sized rectal tube for the same purpose. After delivery, free bleeding by the natural route should be encouraged—without ergot—and venesection practised under the following circumstances: (1) when there is diminution below normal, or cessation of the lochial discharge; (2) recurrence of the convulsions after they have once ceased, and (3) when the symptoms, including the blood-pressure and convulsions, do not respond promptly to the plan of treatment adopted.

Although the use of **veratrum viride** has been highly praised by many American writers, Williams obtained no definite results therefrom, and Summer's statistics show a maternal mortality of 45 per cent.

Englemann employed intravenous injections of 0.2 to 0.3 Gm. (3 to 5 grains) of **hirudin** (leech extract) in a liter (quart) of Ringer's solution, with favorable results in a series of cases. Coagulation of the blood is inhibited thereby and thrombosis prevented. Its use is recommended in severe post-partum eclampsia, but a wider experience is necessary to establish its value in this condition.

Nitroglycerin, in the dosage of $\frac{1}{50}$ grain (0.0013 Gm.) hypodermically, repeated *pro re nata*, will tend to relieve the headache and also the kidney tension. When the convulsions appear suddenly, **morphine**, 1 grain (0.06 Gm.) in divided doses hypodermically, is called for until **chloroform**

anesthesia to the surgical degree is secured; but otherwise opium and its derivatives should not be countenanced, because of their tendency to inhibit secretion from the intestinal canal and from the kidneys, thus defeating the prime therapeutic aim, which is to increase secretion and excretion. Inasmuch, however, as chloroform has a deleterious action upon the liver, Williams advises against its use.

During the attack, in order to prevent the patient from biting her tongue, a **thick cord or folded towel** should be **placed between the teeth**. During the unconscious stage, no food and as little medicine by mouth as possible should be given, in order to prevent particles from entering the air-passages, instead of being swallowed, and later causing inspiration pneumonia. When consciousness is regained, fluids should be forced. While the plan of treatment must of necessity be varied according to the individual condition, that which has served the writer to the best purpose from the onset of the convulsions, summed up, is about as follows: 2 or 3 grains (0.12 to 0.2 Gm.) of **calomel**, placed on the back of the tongue or 2 minims (0.12 c.c.) of **croton oil** in $\frac{1}{2}$ ounce (15 c.c.) of **olive oil**, if the patient can swallow; if not, it is administered through a stomach-tube. Calomel has the preference, however. A high enema, consisting of $\frac{1}{2}$ ounce (15 c.c.) of **glycerin**, 3 ounces (90 Gm.) of **Epsom salts**, and 6 or 8 ounces (180 or 240 c.c.) of **normal saline**. Following evacuation of the bowels, **sodium bromide**, 40 grains (2.6 Gm.), and **chloral hydrate**, 15 grains (1 Gm.), suspended in 6 ounces (180 c.c.) of **normal saline**, are given by rectum.

The bromide may be repeated, without the chloral, every three or four hours. In the mean time the patient is placed in a **hot pack** for twenty minutes or until moderate diaphoresis is established, but not to the point of exhaustion. Sweating, by reason of having been carried to extremes, has caused the pendulum to swing too far in the opposite direction. An **ice-cap** is kept to the head while in pack, and **water** by mouth is administered freely, if the patient can swallow; if not, **normal saline** or preferably the more **alkaline solution** is given by the Murphy method, at intervals of three hours. Tincture of **veratrum viride** (Norwood), 15 minims (1 c.c.), is administered hypodermically and repeated every hour in decreased doses until the pulse is perceptibly softened and slowed. At the onset of the convulsions, **morphine sulphate**, $\frac{1}{3}$ grain (0.02 Gm.), is administered hypodermically and repeated in an hour if the convulsions continue. **Chloroform** inhalation is administered just prior to the convulsions, if they can be anticipated by the restlessness and twitchings of the patient, and discontinued during the stage of stupor. If administered in this manner and with **oxygen**, as it should be, if available, there is practically no danger of any chemical effect upon the liver—an effect to be feared when chloroform is used carelessly.

Krönig obtained favorable results from the employment of **lumbar puncture**, but it is considered of doubtful value by others who have used this procedure.

Renal decapsulation may be employed with advantage as a last resort in cases which show a total suppression of urine following delivery.

Surgical Treatment.—When the symptoms which forbode the development of eclampsia do not yield to the dietetic, hygienic, and medicinal treatment outlined, or the convulsions actually occur, and recur in increased frequency and severity, the time for temporizing has past. With 2 or 3 convulsions, then, increasing in frequency and severity, and the patient not recovering consciousness between them, in spite of treatment, the indications to **evacuation** of the **uterus** are well established, and surgical intervention is imperative. The nearer to term, the easier the procedure of emptying the uterus; the same statement applies to the multipara as to the primipara. The methods of procedure are briefly as follows: Under strict asepsis and antisepsis, including thorough vaginal irrigation, a **rubber tube** is passed well into the **uterine cavity** between the fetal membranes and decidua, and the vagina tamponed with sterile gauze. Ordinarily dilatation is sufficient if the tube is of moderate size; if insufficient, the **bar dilator** may be used, and the necessary dilation accomplished with a few whiffs of chloroform inhalation. The cervical portion of the uterus is not very sensitive and can be grasped with a double tenaculum during the introduction of the tube, otherwise the tube is liable to curl upon itself and the contractions be unnecessarily delayed. If the blood-pressure is high, it will be advantageous to purposely rupture the membranes; if not, there need be no necessity for rupturing them as the tube passes readily between the chorion and decidua. The rectal tube should be from three-fourths of an inch to an inch longer

than the uterine sound from which it is introduced. The sound is bent to the proper angle and carried just within the cervix, when the tube is slipped from off the sound, while the uterus is being held in the proper position. Labor is then allowed to come on gradually, which may require from four to twelve hours and possibly longer, if the tube is not well placed. If the condition is urgent, the **hydrostatic bag** may be introduced, hastening the dilation process, and **dilation** completed by the **bimanual** method. If the condition is desperate and the symptoms grave, rapid dilation may be effected by the use of the hydrostatic bag, with intermittent traction, followed by rapid manual dilation, under chloroform anesthesia (with oxygen), and delivery with forceps or by version.

If the cervix is rigid and unyielding (characteristic of the primipara, with whom five out of six eclampsias occur), the **Dührssen incisions** may be made, or **vaginal hysterotomy** may be performed. In the absence of disproportion, vaginal hysterotomy offers a very much better opportunity for recovery than the suprapubic Cæsarean section. No toxic person is a good subject for this major operation, and I have always limited it to pelvic contraction or disproportion from other causes.

Where surgical intervention is imperative, Williams prefers **vaginal hysterotomy** to abdominal **Cæsarean section**, as recommended by Halbertsma, since the former is less dangerous and convalescence is more quickly established. He considers that the latter is only indicated where a contracted pelvis, tumor formations, or conditions exist which would de-

mand its use, aside from the presence of the eclampsia. In post-partum eclampsia, the treatment consists of **elimination**; free purgation with **elaterium** or the **saline cathartics**; **high colonic irrigation** with the **alkaline solution**, or by the **continuous drop method** in the **Fowler position**; **veratrum viride** and the **nitrites**. The indications for the use of **morphine**, the **bromides**, **chloroform**, and **venesection**, as previously described, here apply, except that venesection may be more frequently indicated in the sthenic, while hypodermoclysis or the intravenous injection of the **saline solution** will be more frequently indicated in the asthenic type of individual. The after-treatment consists of **liquid diet**, largely **alkalinized milk**, and keeping active the secretions and excretions. No stimulating diuretics should be administered until readjustment of the kidneys takes place. After the convulsions have ceased, a sedative diuretic, also a hepatic and gastrointestinal stimulant, are indicated. That which, for this purpose, seems to give the best results, and shortens the comatose stage, is fluid extract **stigmatum maidis** (corn-silk) ʒj (4 c.c.), with or without 1-minim (0.06 c.c.) doses **nitroglycerin**, combined with compound elixir of **taraxacum** ʒj (0.06 c.c.) every four hours. Later, **Basham's mixture**, reinforced with 5 minims (0.3 c.c.) of tincture of **chloride of iron**, especially if the patient is anæmic, is useful.

In the nephritic type of eclampsia increased blood-pressure is an early symptom, antedating albuminuria, while in the hepatic type there is usually an absence of urinary findings. In the pre-eclamptic state there is a failure on the part of the organism to eliminate the excess of toxic products. This

failure may be due to one or both of the following: (1) Chronic nephritis. (2) an insufficient margin of elimination in either the normal or the diseased kidneys.

With normal kidneys prophylactic treatment gives brilliant results. It consists of overcoming deficient renal elimination by intelligent use of the **hot pack** combined with administration of tincture of **digitalis**. When symptomatic treatment is indicated, **veratrum viride** should be borne in mind. When medicinal treatment fails, **operative treatment** will also probably fail. F. J. Smith (Jour. Iowa Med. Soc., ix, 268, 1919).

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PUERPERAL INSANITY. See
PSYCHOSES: PUERPERAL INSANITY.

PUERPERAL SEPSIS. See
WOUNDS, SEPTIC, AND SEPSIS.

PURPURA.—Purpura (hemorrhea petechialis, Blutfleckenkrankheit) is a hemorrhagic cutaneous affection characterized by the appearance on the skin of hemorrhagic patches or macules, of various sizes and shapes, reddish purple in color, and not disappearing under pressure.

It is so often associated with other diseases that strictly speaking it should rather be regarded as a symptom. In the infectious eruptive diseases (scarlet fever, measles, and smallpox) its appearance, although comparatively rare, is usually an indication of malignancy. It is a regular feature of the eruptions in typhus fever and cerebrospinal meningitis. It may occur in malaria, diphtheria, and septic disorders. Finally, it is also observed unassociated with serious infectious disease.

Three varieties of purpura are usually recognized, differing in premonitory and constitutional symptoms, in the extent of the hemorrhagic extravasations, and in their causation: purpura simplex, purpura rheumatica, and purpura hemorrhagica.

SYMPTOMS.—Purpura simplex usually appears suddenly overnight, but sometimes gradually in the course of several days. The eruption consists of bright or deep-

red or purplish spots, variously shaped, and in size from a pin's point to that of a pea. They are circumscribed, not elevated, are situated deep in the skin, do not disappear on pressure, are symmetrically distributed, and are chiefly found on the lower extremities, especially the thighs. Subjective symptoms are usually absent, except a general soreness of the skin. Occasionally there may be moderate itching, slight lassitude, and malaise, rarely pain. When wheals develop as a complication, the itching may be severe and the condition is called *purpura urticans*. In one or two weeks the disease has usually run its course, but it may be prolonged for months by the appearance of successive crops of the eruption. It occurs generally in debilitated and, especially, old persons.

Purpura rheumatica (peliosis rheumatica; Schönlein's disease) is preceded or accompanied by lassitude, despondency, anorexia, constipation, fever, and rheumatoid pains, particularly in the lower extremities, about the joints. One or more joints may be swollen. After several days or a week the eruption appears, principally on the abdomen and limbs. The spots are circumscribed, somewhat raised or on a level with the skin, split-pea to finger-nail in size; at first pink, reddish, or purple, they later assume the color changes common to an ecchymosis, changing into yellowish and greenish tints, and then disappearing entirely. Rarely a hemorrhagic spot becomes gangrenous. The rheumatoid pains may either abate or disappear with the appearance of the eruption; in many cases the constitutional symptoms continue throughout the disease or appear as relapses, with successive crops of the eruption. The disease is uncertain as to course and duration. Hemorrhage from the internal organs, most often the kidneys, may occur as a complication and may prove fatal. Gastrointestinal disturbances (colic, vomiting, diarrhea) may appear as complications, and less frequently hemorrhage from the stomach or bowels, which may induce local necrosis, perforation, and peritonitis.

This form of purpura is rare and is somewhat related to erythema multiforme, with which it may be associated. It is

occasionally met with in children and young adults, and usually occurs in persons having a rheumatic history or heredity.

Purpura hemorrhagica (Werlhof's disease) is a severe form of the disease. The onset is preceded or accompanied by marked constitutional symptoms of systemic depression and fever. Hemorrhagic spots suddenly appear, varying in size from a small coin to the palm of the hand, usually first on the limbs, and then on other parts of the body. They may be noticed on the hard palate, the inside of the cheeks and other parts of the mouth. In exceptional cases there is an extravasation beneath the epidermis, giving rise to a blood-blister. Coincident with or shortly after the appearance of the eruption, hemorrhages may occur from the mucous membranes, especially the mouth, gums, nose, fauces, bowels, and kidneys. Hemoptysis, effusions beneath the conjunctiva, into the retina, choroid, and sclerotic, and metrorrhagia have been reported. Meningeal or cerebral hemorrhage may give rise to epileptiform seizures and paralysis.

The course and duration of the disease are uncertain. It may terminate suddenly in a week or two, or may continue longer. It is a dangerous disease, and death not infrequently occurs. Debility, neurasthenia, and deficient nutrition predispose to this disease, but it may occur in the apparently robust. Relapses are common.

Under the name of *purpura fulminans*, *purpura foudroyante*, *angioneurotic edema*, and *Henoch's purpura*, a number of cases occurring in children have been described, the chief features of which are: an eruption of purpuric spots, variously distributed, with or without articular pain and swelling, colic with tenderness over some part of the colon, occasionally vomiting, generally more or less hemorrhage from the bowel, and sometimes hematuria and acute nephritis. As a rule there is but little fever, but a tendency to relapse, the purpuric spots and intestinal hemorrhage recurring, so that the disease may be weeks or months in duration, followed by convalescence; but when severe nephritis complicates, it may prove fatal, death coming on rapidly with profound toxic or septic symptoms.

DIAGNOSIS.—The characteristic lesions, uninfluenced by pressure, usually render the diagnosis clear. Purpura hemorrhagica, however, may be confounded with *scorbutus* (*scurvy*), but the former has no etiological relationship to lack of vegetable food and bad hygiene, has slight or no prodromata, a sudden onset, less marked muscular pains, absence of brawny infiltration of lower extremities and hemorrhages from mucous membranes so severe as to be often fatal. The gums often bleed in both diseases, but in purpura they are not swollen. Chronic purpura may be confounded with *hemophilia*; purpura, however, is neither congenital nor hereditary. In hemophilia there is a diminution of coagulability of the blood, but the clot, when formed, contracts; in purpura, coagulation is normal, but the clot does not contract. In hemophilia the blood-platelets remain about normal, while in purpura there is a marked diminution in their number, sometimes almost to the point of absence.

ETIOLOGY AND PATHOLOGY.—Purpura is generally considered to be due to the action of a poison on the blood and the walls of the blood-vessels. It is common in the various infectious diseases and may be caused by drugs (iodides, bromides, arsenic, chloral, copaiba, quinine, salicylates, etc.) in susceptible subjects, and by auto-toxins resulting from faulty metabolism, which latter gives rise to the larger number of cases. Renal disease or insufficiency is not infrequently present. Purpura, erythema multiforme, urticaria, and angioneurotic edema are in many cases regarded by Osler as interchangeable expressions of errors of metabolism. Purpura has been observed to follow an injection of diphtheria antitoxin. Purpura hemorrhagica of a severe type may occur during menstruation and pregnancy and not infrequently lead to death; occurring during pregnancy, it leads to abortion or premature delivery. Purpura sometimes appears during or subsequent to typhoid fever and other infectious diseases, as acute rheumatism, and may closely follow an acute tonsillitis. In Henoch's purpura the pathological manifestations vary from simple hemorrhage and edema to intussusception, gangrene, perforation, peritonitis, and death.

PROGNOSIS.—The prognosis in purpura simplex and purpura rheumatica is favorable; in a few weeks or months recovery may be expected. In purpura hemorrhagica, however, the prognosis depends largely on the cause; prognosis should be guarded, as death not infrequently occurs from internal hemorrhage, anemia, heart-failure with pulmonary edema, or from cerebral hemorrhage.

TREATMENT.—The treatment will depend upon the cause. Patients who have a rheumatic history and symptoms will be benefited by the use of **salicin**, the **salicylates**, **alkalies**, and other antirheumatic remedies. Attention to **diet** and **hygiene** is necessary. **Rest** is valuable, and if the hemorrhage is extensive it is obligatory that the patient assume and keep the **recumbent posture**. While in most cases the underlying disease is the more important, **tincture of iron chloride**, **quinine**, **turpentine**, and the **mineral acids** are beneficial in all forms of the disease. Schamberg has found **turpentine** in 5-minim (0.3 c.c.) doses, given in emulsion with tragacanth and flavored with lemon-syrup, to be particularly efficacious.

In chronic purpura Edgeworth found that **turpentine** controlled the violent outbursts of bleeding, and **arsenic** apparently caused a cessation of all symptoms. In chronic syphilitic purpura **potassium iodide** will invariably give good results. Elsner and Meader recommended injections of **rabbit serum** made during ten-day periods, the dose and number of injections to depend on a close study of the effects of a safe initial and second dose. Large doses are unnecessary.

Calcium chloride in doses of 3 to 4 grains (0.2 to 0.25 Gm.) given three times daily is favored by Russell, who also places the patient on a diet of **raw meat** and fresh **milk**; Matthews and Carpenter give 20-grain (1.3 Gm.) doses thrice daily. Muggia advises the use of **antidiphtheritic serum** early in the attack.

In purpura hemorrhagica **horse serum** may be injected intramuscularly in doses of 2½ drams (10 c.c.), **calcium lactate** given in 2-grain (0.13 Gm.) doses every two hours, and **gelatin** and **orange-juice** freely administered by mouth, as suggested by Bodenheimer. Goldstein ad-

vises **antidiphtheritic serum** injected in doses of 4 to 5 drams (15 to 20 c.c.). Duffield advises **direct transfusion** in these cases, and suggests that the donor should not be a blood relation of the patient.

Locally, **astringent lotions** and **ice**, in suitable cases, may be used. S.

PUSTULE, MALIGNANT. See ANTHRAX.

PYELITIS. See KIDNEYS, DISEASES OF.

PYEMIA. See WOUNDS, SEPTIC.

PYLORUS, DISEASES OF. See STOMACH, DISEASES OF.

PYOPNEUMOTHORAX. See PLEURA, DISEASES OF: PNEUMOTHORAX.

PYORRHEA ALVEOLARIS. See RIGGS'S DISEASE.

PYOSALPINX. See OVARIES AND FALLOPIAN TUBES, DISEASES OF.

PYOTHORAX. See PLEURA, DISEASES OF.

PYRAMIDON.—Pyramidon, or dimethylaminoantipyrin ($C_{11}H_{11}N_2ON-(CH_3)_2$), is a substitution compound of antipyrin. It occurs in yellowish-white or colorless crystals, without taste, and soluble in alcohol and in 10 parts of water. It is not official. It is used in doses of from 5 to 8 grains (0.3 to 0.5 Gm.).

Pyramidon monocamphorate (neutral) occurs as a white, crystalline powder, soluble in cold and hot water, alcohol, and ether. It is used in doses of from 8 to 12 grains (0.5 to 0.75 Gm.).

Pyramidon bicamphorate (acid) occurs as a white, crystalline powder of acid reaction, soluble in 20 parts of water and in 4 parts of alcohol. It is used in doses of from 8 to 15 grains (0.5 to 1 Gm.).

Pyramidon salicylate occurs as a white crystalline powder, soluble with an acid reaction in 16 parts of water and in 5 to 6 parts of alcohol. It is given in doses of from 8 to 12 grains (0.5 to 0.75 Gm.).

PHYSIOLOGICAL ACTION.—According to Filehne, the action of pyramidon on the nervous system is similar in all respects to that of antipyrin. The

mechanism of its antipyretic action is the same; it lowers the body temperature by increasing the dissipation of heat. There are, however, minor differences of effect: pyramidon is required in doses only a third as large, and its antipyretic action is produced more gradually and lasts longer. Animals poisoned by very large doses of pyramidon exhibit no material alteration of the blood, either microscopically or spectroscopically, and no hemorrhages, thromboses, nor organic degenerations. In the healthy human subject, doses of 8 grains (0.5 Gm.) produce neither subjective nor objective effects.

A. Robin and G. Bardet have found that pyramidon in small doses exerts a stronger analgesic influence than antipyrin, and is not followed by the untoward effects incident to the use of the latter. While antipyrin diminishes the quantity of urea excreted by checking metabolic changes, pyramidon, on the other hand, tends to augment it in consequence of the increased metabolism which it excites. In fevers they have found that the coefficient of oxygenation is increased by the use of pyramidon; the quantity of urea is not lessened, but may be increased. In diabetes both the urea and sugar are increased,—the opposite of the effect of antipyrin.

W. Pauli reports 2 instances in which the use of pyramidon was followed by untoward effects. In 1 case, after 5-grain (0.3 Gm.) doses there was painful paresthesia of both forearms, which radiated into the fingers and increased in severity on the following day. In 3 similar cases in which this dosage was given sleeplessness resulted, which disappeared on cessation of the remedy, but returned when the same dose was repeated. The second patient showed an eruption which resembled urticaria, over the face, neck, arms, joints, and chest. Upon the face these spots became confluent and later resembled the eruption of measles. Robin and Bardet observe that, as the dose of pyramidon is smaller than that of antipyrin, it is less likely to cause cutaneous eruptions. No injurious effects have been noticed upon gastric function, the circulation, or upon the heart, even when the action of the latter was weak.

THERAPEUTIC USES.—The value of pyramidon rests mainly upon its antipyretic and analgesic properties. In the treatment of **typhoid fever**, M. John considers pyramidon at least as useful as hydrotherapy, he having tried it in 38 severe cases. In 1 case where the administration of several baths a day for a week had failed to remove either the stupor or the serious weakness of the circulation, pyramidon given in doses of $2\frac{1}{3}$ grains (0.15 Gm.) every three hours for two consecutive days cleared the patient's mind, reduced the fever and caused definite manifestations of general improvement. The same effects were obtained in 9 other delirious and totally unconscious patients, usually after two or three days of treatment. The drug failed in only 1 case, in which exceedingly numerous ulcerations were found throughout the ileum and cecum; 3 other patients died, 1 from cardiac failure, 1 from perforative peritonitis, and 1 from intestinal hemorrhage. Small doses are usually prescribed, $1\frac{1}{2}$ grains (0.1 Gm.) every two hours, or $2\frac{1}{3}$ grains (0.15 Gm.) every three hours until the temperature and general condition are not markedly altered on tentatively discontinuing the medication for one or two days.

Hirtz observed sudden decline of temperature in several **typhoid** patients after doses of $2\frac{1}{3}$ to 3 grains (0.15 to 0.2 Gm.) of pyramidon in combination with caffeine, and 1 patient suffered with severe vomiting, so that intestinal perforation might have been suspected. During the febrile period, therefore, he favors doses not exceeding $\frac{3}{4}$ grain (0.05 Gm.) of pyramidon combined with caffeine.

Feuerstein used pyramidon as an antipyretic in 42 cases of **phthisis**, in all stages of consolidation, using single doses of $3\frac{1}{3}$, 5, and 10 grains (0.2, 0.3, and 0.6 Gm.). In all cases the temperature declined gradually, reaching its lowest point in about two hours, where it remained for from four to six hours, and then gradually rose. Complete defervescence could be obtained from 10 grains (0.6 Gm.) given in doses of $3\frac{1}{3}$ grains (0.2 Gm.) hourly. The longest duration of low temperature was six and the shortest two hours.

Lyonnet tested pyramidon bicamphorate (acid) upon 15 cases of tuberculosis, who

were suffering from severe **night-sweats** and **high fever**, giving $7\frac{1}{2}$ grains (0.5 Gm.) twice daily in form of powder. The remedy was well tolerated and marked general improvement and diminution of the sweats followed.

F. Tauszk has also demonstrated the antipyretic and antihydrotic effects of the camphorates of pyramidon, the antipyretic effect being greater in the neutral (or mono) camphorate, and the antihydrotic action prevailing in the acid, or bicamphorate. The salicylate, he finds, is especially indicated in tuberculosis complicated with pleurisy.

Rahn has employed the monocamphorate (neutral) and bicamphorate (acid) in various **febrile pulmonary affections** and in **inflammations of serous membranes**. He alternates the camphorates, giving daily doses of from 6 to 12 grains of the neutral camphorate, and from 10 to 15 grains (0.6 to 1 Gm.) of the acid camphorate. He also found the camphorates valuable in **acute, subacute, and chronic inflammation of the lungs, of tuberculous and catarrhal character; in febrile bronchitis, fibrinous and purulent; in dry and exudative pleurisy; and in influenza complicated by pneumonia or pleurisy.**

Filehne proved the efficacy of pyramidon as an antipyretic in **typhus and scarlet fevers, influenzal pneumonia, and pseudo-leukemia.**

The analgesic effects of pyramidon have been studied by Filehne, who found that it promptly relieved pain of various kinds, such as **febrile headache**, pain in the lymph-glands and the spleen in **pseudo-leukemia**, that of **tuberculous peritonitis, anemia, and multiple neuritis and intercostal neuralgia** occurring as a sequel of **influenza**. In **headaches**, 6 grains (0.4 Gm.) are sufficient.

In **rheumatic affections**, especially in **acute and chronic rheumatism, gout, neuralgias**, and in **dry and exudative pleurisy** pyramidon salicylate is indicated. Rahn confirms the observations of Landenheimer as to the efficacy of pyramidon salicylate in the **headache of alcoholics.**

Karl Martin found pyramidon salicylate beneficial in **herpes zoster**, giving prompt relief to the severe pain.

Vogt advises pyramidon in the **lightning**

pains of locomotor ataxia, in a single dose of $7\frac{1}{2}$ grains (0.5 Gm.) followed by one or two cups of hot milk or tea; the pain diminishes in twenty minutes and often entirely disappears in a half-hour. Landenheimer confirms this, but finds that the benefit is only temporary. He has not observed any beneficial action following the use of pyramidon in chronic rheumatism.

In diabetes pyramidon is contraindicated, as it increases the output of sugar.
W.

PYROGALLOL.—Pyrogallol, U. S. P., or pyrogallic acid, is a triatomic phenol, obtained chiefly by the dry distillation of gallic acid. It occurs in white, lustrous, odorless scales or needles, having a bitter taste and soluble in 2 parts of water, 1 of alcohol, and 2 of ether. It is a strong reducing agent, to which property it largely owes its therapeutic effects. It darkens on exposure to light. Its watery solutions, or even the moistened crystals, in contact with the air, absorb oxygen and acquire a brown color; the reaction of the fluid also changes from neutral to acid. The color change takes place more rapidly if a caustic alkali is present in the solution. It is not administered internally. It is used externally in ointment and in powder (5 to 10 per cent.). The stronger ointments have a caustic effect. Pyrogallol possesses antiseptic properties.

POISONING BY PYROGALLOL.—The incautious application of pyrogallol may cause inflammation of the skin up to the point of ulceration and sloughing. Fatal intoxication has followed the inunction of one-half the body with a 10 per cent. ointment, the surface being afterward covered by gutta-percha tissue and a bandage (Neisser). The symptoms began within two hours, with rigors, diarrhea, vomiting, and strangury. The next day the urine was very dark colored (hemoglobinuria); all the symptoms became aggravated, with apathy, dyspnea, exaggerated reflexes, and collapse, followed by death two days later.

A severe case of poisoning from pyrogallic acid is reported, in which it was employed in ointment form for psoriasis.

Treatment of Poisoning by Pyrogallol.—On the first appearance of gastrointestinal disturbance, strangury, or smoky urine, the remedy should be at once discontinued. Neisser suggests, further, the subcutaneous injections of ether, alcoholics frequently repeated, energetic stimulation of the surfaces and the inhalation of oxygen. The mineral acids act as antidotes.

THERAPEUTICS.—Pyrogallol was introduced in 1878 by Jarisch as a remedy in psoriasis and lupus. It has since been shown to be of value in parasitic skin diseases, as eczema marginatum, in epithelioma, in simple chancre, and in phagedena. Unfortunately, it stains the skin, hair and nails, as well as linen apparel with which it comes in contact.

In psoriasis a 10 to 15 per cent. ointment is thoroughly rubbed into the affected areas. In lupus pyrogallol acts upon the diseased tissues as a mild escharotic. The rapidity of its action is increased when the epidermis is intact by first applying a moderately strong solution of caustic potash. A 10 to 20 per cent. ointment is applied on lint, and covered with a piece of gutta-percha tis-

sue, which may be made to adhere to the skin by moistening its edges with chloroform. The applications are renewed daily for two to seven days, until the lupus patch has been converted into a gray, pultaceous mass. Iodoform ointment or a mercurial plaster is then applied. This treatment is applied at intervals so long as any lupus tubercles are visible.

In lupus Besnier has used a saturated solution of pyrogallol in ether, which he brushes over the lupus patch and covers with traumaticin. Brocq prefers a solution of pyrogallol with salicylic acid (10 per cent. of each) in collodion.

In tuberculosis of the skin the affected tissues may be destroyed with an ointment composed of petrolatum containing 10 per cent. of pyrogallol; this is spread on lint and applied to the part for three to five days. The wound so produced is then allowed to heal, being dressed with a petrolatum ointment containing from $\frac{1}{2}$ to 2 per cent. of pyrogallol.

Epithelioma is treated in the same way as lupus. In simple chancre Vidal used a 25 per cent. ointment and for phagedena a powder of pyrogallol and starch (1 to 4). S.

Q

QUARTAN FEVER. See MALARIAL FEVERS.

QUASSIA.—Quassia, U. S. P., is the wood of *Picrasma excelsa*, or of *Quassia amara* (family, Simarubaceæ): a large tree indigenous to Jamaica and other parts of the West Indies. It occurs usually in the form of small chips or raspings, nearly white in color, odorless, but very bitter. The wood is sometimes turned into cups, which are used by pouring hot water into them, and allowing it to remain for several hours; the water becomes quite bitter, having absorbed the bitter principle from the wooden cup. Quassia contains a bitter, neutral principle, quassin (quassiin), which occurs in white, opaque, intensely bitter crystals; is soluble in alcohol, hot water, and chloroform, and slightly soluble in cold

water. It also contains a minute quantity of a volatile oil, but no tannin. The fluid extract is an alcoholic preparation. The tincture of the present Pharmacopœia (1905) is 50 per cent. stronger than of the former one (1890).

PREPARATIONS AND DOSES.—*Quassia*, U. S. P. (the wood or crude drug). Dose, 5 to 10 grains (0.3 to 0.6 Gm.).

Tinctura quassiae, U. S. P. (tincture, 20 per cent). Dose, 15 to 60 minims (1 to 4 c.c.).

Extractum quassiae, N. F. (solid aqueous extract), 1 to 3 grains (0.06 to 0.2 Gm.).

Fluidextractum quassiae, N. F. (fluid-extract), 5 to 15 minims (0.03 to 1 c.c.).

POISONING BY QUASSIA.—Taken in overdose, quassia acts as an irritant of the mucous membrane of the stomach and

as a nauseant. Potter reports serious symptoms of narcotism from quassia in a child of 4 years. In dose of about $\frac{1}{4}$ grain (0.015 Gm.). Campardon found quassia to produce severe headache, severe burning pain in the throat and esophagus, nausea, vertigo, restlessness, diarrhea, and frequent passage, but diminished secretion of urine. F. Venn, of Chicago, reported a fatal case of poisoning from a decoction of 2 ounces (60 c.c.) of quassia injected into the rectum of a child for the treatment of seat-worms.

THERAPEUTICS.—Quassia is a simple bitter without astringency, and has been found useful in **convalescence from acute fevers** to increase the appetite and improve the digestion. In **atony of the stomach, or simple dyspepsia** with eructations after meals, the administration of quassia is followed by good results. It is used in **diarrhea from indigestion** and as a stomachic in **malarial affections**. An infusion of quassia—1 to 2 ounces (30 to 60 Gm.) to the pint (500 c.c.) of boiling water—is a reliable remedy, given as an enema, to destroy thread-worms (*ascarides*) in children. Before giving the enema—from $\frac{1}{2}$ ounce to 1 pint (15 to 500 c.c.)—the bowel should be well washed out by injections of soap and water. The enema should be retained for some minutes. S.

QUEBRACHO.—Quebracho, or *Aspidosperma*, is the bark of the *Aspidosperma quebracho-blanco* (family, Apocynaceæ): a large tree indigenous to Brazil and Catamarca (Argentine Republic). It contains 6 alkaloids: Aspidospermine, aspidospermatine, aspidosamine, quebrachine, hypoquebrachine, and quebrachamine. Quebrachine is the most used.

PREPARATIONS AND DOSES.—*Aspidosperma*, U. S. P. (*aspidosperma*; *quebracho*). Dose, 1 dram (4 Gm.).

Fluidextractum aspidospermatis, U. S. P. (fluidextract of *aspidosperma* or *quebracho*). Made by extraction with a mix-

ture of glycerin, 11; alcohol, 67, and water, 22. Dose, 1 fluidram (4 c.c.).

The sulphates of aspidospermine and quebrachine have been used internally and by hypodermic in doses of from 1 to 2 grains (0.06 to 0.12 Gm.).

POISONING BY QUEBRACHO AND PHYSIOLOGICAL ACTION.—In toxic doses quebracho causes salivation, paralysis of respiration, and diminished action of the heart and convulsions; death is caused by paralysis of the respiratory center. After prolonged medicinal use, quebracho appears to cause a disturbance of the sympathetic nervous system. The blood of animals poisoned by quebracho becomes red. Bardet found that it distinctly increases the depth of the respiratory movements, retards the pulse (contrary to Penzoldt's view), and causes a fall in the temperature.

Quebrachine, according to Douglas Cow, is by far the most toxic of the 4 alkaloids investigated. In small doses it stimulates the central nervous system, causing deeper and quicker respirations. In large doses it has a paralyzing effect on the nerve-cells of the autonomic system, brain, and cord. In still larger doses it paralyzes the vagus, the sympathetic, and the motor nerve-endings belonging to the curare-nicotine-coniine group of drugs. It causes death by paralyzing the respiratory center at a time when the motor nerves are still responsive to electrical stimulation.

THERAPEUTICS.—Quebracho is sometimes employed in the various forms of **dyspnea**, on account of its stimulant action on the respiratory system. It has also been employed in the treatment of **asthmatic conditions**, but while it may act as a palliative in **bronchial asthma**, it is without beneficial action in asthma of cardiac or renal origin. S.

QUICKSILVER. See MERCURY.

QUININE. See CINCINA.

R

RABIES (Hydrophobia; Madness).—**DEFINITION.**—Rabies is an acute infectious disease of animals occasionally communicated to man, characterized by excitement, hyperesthesia, deglutitionary spasm, and paralytic weakness, caused by a specific but unknown virus and which when not specifically treated ends in death.

INCUBATION.—This varies widely in different cases. It is shorter in children than in adults, and in wounds about the face, head, and hands, or uncovered parts, than in the case of injuries received in other parts of the body through the clothing. The severity and character of the wound also influence the time of onset, the symptoms appearing sooner in cases of infection from punctured and lacerated wounds.

The incubationary period ranges between three and eight weeks, but it may be, in occasional instances, six months or even a year or more. The wound through which infection takes place has usually healed entirely before any symptom of rabies is apparent, but in some cases, when the disease appears, the wound becomes irritated and again inflamed. Of persons bitten by *rabid* dogs, only a small proportion—10 to 20 per cent.—become infected.

Early symptom of rabies observed by the writer in animals and man, which has received very little notice in literature. This is a left hemiplegia, starting in the hinder leg in the lower animals and simulating Landry's paralysis. He has observed it in over 200 rabbits inoculated with rabies, as well as in a number of animals infected otherwise. He also

had the opportunity to observe a fatal case in man in which this symptom of lower left hemiplegia occurred. It has been noticed in man, the hog, the dog, the guinea-pig, and the rabbit; in all of the quadrupeds the initial paralysis was in the left hind leg and in the man the left leg and it gradually developed into a left hemiplegia which later became general. He concludes that in an animal that has suddenly become extremely nervous and irritable, the development of a weakness in the left hind leg without apparent cause warrants a tentative diagnosis of rabies. M. B. Wesson (Jour. Amer. Med. Assoc., April 5, 1913).

SYMPTOMS.—The early symptoms in man are: general nervousness, with irritability, wakefulness, and depression of spirits. There is often headache and vague uneasiness, sometimes slight fever and rapid pulse, and the wound may become painful and the surrounding tissue show anesthesia. Some slight stiffness about the muscles of the throat is now noted, the voice changes or becomes husky, and swallowing becomes difficult.

After a short time great restlessness and excitement supervene, together with general hyperesthesia and abnormal reaction to external impressions of all kinds, to the extent, so soon as the height of the attack is reached, of causing reflex spasms. These spasms are quite distressing and severe, and involve particularly the muscles of the larynx, pharynx, and mouth, and are accompanied by a sense of intense dyspnea. Attempts at swallowing or taking water precipitate the violent and painful spasmodic attacks, which fact causes the patient to dread even the

sight of water; whence the common name of the disease: "hydrophobia."

There is often at this stage some mental disturbance, greatest at time of the deglutitionary and respiratory spasms, subsiding in the interval. In other cases delusions and hallucinations, with maniacal excitement, may continue throughout the attack. In some cases there are more general convulsive seizures, resembling, somewhat, those of tetanus. The disease may run its course without rise of temperature, but most cases show some febrile reaction, 100° to 102° being usual. There is oftentimes a copious secretion of saliva, which, owing to the difficulty in swallowing, is allowed to run from the mouth.

The acute spasmodic stage lasts for a day or two, and is then succeeded by a paralytic stage, in which the patient lies quiet, nearly helpless, confused, and finally unconscious. The heart-action becomes progressively more feeble, the respiration shallow and increased in frequency, and death ensues.

In man the initial stage of excitement is rarely absent. But in animals its absence is the usual rule, the stage of paralysis quickly supervening upon the first symptoms of the disease.

Pseudorabies, or Lyssophobia.—Mention should here be made of this condition, *i.e.*, the morbid fear of hydrophobia, leading, by the influence of autosuggestion, to a group of nervous and hysterical manifestations closely simulating true rabies. A neurotic person of inherited nervous instability and easily influenced by suggestion is bitten by a dog supposed to be mad; after a variable time and often in direct consequence

of having been joked about the danger, or from brooding over the possibility of an attack of the disease, some nervous symptoms paralleling those of rabies appear. The subject becomes apprehensive, despondent, restless, then excited, and exhibits some spasm or a choking sensation in the throat, this being often only a perversion of the frequently seen *globus hystericus*. Occasionally convulsive attacks of an hysteroid character occur. The patient exaggerates the danger and protests that he is really going mad. Other varied hysterical phenomena may be present. The attack does not progress, however: there is no disturbance of general health nor of any of the bodily functions, no temperature changes, no weakness, no prostration. The attack lasts for days or weeks and then subsides. Probably no case has ever proved fatal, the alleged fatal cases being instances of true rabies, as, on the other hand, many of the cases of reported recovery from rabies are most likely instances of the pseudo-affection.

DIAGNOSIS.—While there should be no difficulty in distinguishing between rabies and other affections of the nervous system in which spasms and cramp occur, it is sometimes confounded with tetanus, hysteria, and acute mania.

In *tetanus* there is the typical trismus and an absence of any dread of water and of spasms during intervals. There is no risus sardonicus, anxiety, or restless irritability. The character of the wound in tetanus is also different and the incubationary period much shorter.

Hysteria sometimes gives rise to a condition which resembles rabies,

especially when the patient has been bitten by a dog; there is marked anxiety and convulsions, and sometimes even barking and attempts to bite. The absence of respiratory symptoms, of the risus sardonicus, the absence of spasm during the hysterical convulsions and the history of the case will reveal the true identity of the disorder present.

Mania is distinguished from rabies mainly by its history, the absence of characteristic convulsions and respiratory phenomena, and also absence of rapid aggravation of all symptoms.

Pseudorabies.—The greatest difficulty lies in distinguishing true rabies from the pseudorabies. Here a careful consideration of all symptoms and a complete and searching test of the nerve-reactions may be needed to prevent error. The evident influence of suggestion, the discovery of hysterical tendencies and stigmata, the absence of any real prostration and of any progress in morbid process exclude pseudohydrophobia.

The diagnosis of rabies may be established by noting certain changes in the nervous system pointed out by Van Gehuchten and Nélis in 1900, and especially noticeable in the Gasserian ganglion and the plexiform ganglion of the pneumogastric. The nerve-cells lying in the ganglia are so stimulated by the rabic virus that they proliferate actively until destruction occurs, and are replaced by round cells. These changes occur if the animal is allowed to die of the disease, and not killed prematurely as often happens. The chromatolysis affects all the nerve-cells of the cord, and is followed by retraction of

the cells from the capsules and proliferation of the cells of the latter. The chromatolytic changes are best seen by Nissl's stain, and the capsular changes by means of hematoxylin eosin.

The writer describes a method he has used for several years in the laboratory of the Pasteur Institute of Virginia, a modification of Van Gieson's well-known method for staining for the diagnosis of rabies. It consists essentially in the use of acetone as a solvent for rosanilin in the place of alcohol. When the solution of rosanilin in acetone is diluted with water the stain yields itself so readily to the affinity of the cell inclusion that heat is unnecessary, and the inclusions are quickly tinted a brilliant rose-red color. The stain can be quickly prepared owing to the greater solubility of rosanilin in acetone, and it is not necessary to wait until the solution becomes saturated. The concentrated solution is more stable than that in alcohol and the readiness of the acetone solution to give up the stain enables one to detect the inclusions more certainly in the brains of animals long dead. This conclusion is based on practical comparative tests with the two methods. The following is described as the technique commonly employed: Smears containing pyramidal cells of the hippocampus, or Purkinje cells of the cerebellum, are prepared in the usual manner, allowed to dry, and fixed for two minutes in ethyl or methyl alcohol. They are then dried with blotting-paper and stained; 2 or 3 drops of a saturated solution of rosanilin in acetone (U. S. P.) are added to 10 c.c. of water, which is agitated with the pipette, and soon becomes a brilliant rose-red color. Then 2 drops of a half-saturated, aqueous solution of methylene blue are added, and the stain is applied to the smears. Staining is completed in one or two minutes, without heat. The slide is then washed under the tap, dried, and examined. Should a

weaker than saturated solution be employed, it is only necessary to add more of it, drop by drop, to the water, till the usual brilliant rose-red tint is obtained, when the result will be found about the same as that obtained with the saturated solution. S. B. Moon (*Jour. Amer. Med. Assoc.*, Aug. 26, 1911).

tire period of incubation, and will be still found there when the more distant portions of the nervous system have already become affected.

According to Lentz, smears should be made from at least 3 different parts of gray matter of the central nervous system; first, from the cor-



Negri bodies in the brain. (*Roy and Nichols.*)
(*Washington Med. Annals.*)

In 1903 Negri observed special bodies or structures in the cells of of the central nervous system of animals affected with rabies. If some nervous tissue of a rabid animal be deposited upon the cerebral cortex of a rabbit the virus will be found localized at this site during the en-

tex in the region of the fissure of Rolando or in the region corresponding to it; second, from Ammon's horn; third, from the cerebellum. The smears are to be dried in air and subjected to staining methods. The eosin-methylene-blue staining method is recommended by Mallory. The smears are fixed in Zenker's solution

for 30 minutes; after being rinsed in tap-water they are placed successively in 95 per cent. alcohol-iodine 15 minutes, 95 per cent. alcohol 30 minutes, absolute alcohol 30 minutes, eosin solution 20 minutes, rinsed in tap-water, methylene-blue solution 15 minutes, and dried with filter-paper. With this method of staining the cytoplasm of the bodies is a magenta, light in the small bodies, darker in the larger; the central bodies and chromatoid granules are a very dark blue, the nerve-cell cytoplasm a light blue, the nucleus a darker blue, and the red blood-cells a brilliant eosin pink. The "bodies" and the structure are often more clearly defined with this method, and perhaps, on the whole, it is better to use it for making diagnosis; but when there are only tiny bodies present, or when the brain-tissue is old and soft, the Giemsa stain seems to be the more successful. S. R. Klein (N. Y. Jour. of Med., July, 1910).

The writer found in a series of 667 animals, all of which died from the disease, that the Negri bodies were absent only in 8, or 1.2 per cent. The value of a negative finding in animals dead of rabies is consequently very marked. R. Pirone (Arch. des Sci. Biol., Petrograd, No. 3, 1912).

The time it takes to perform the different tests is about as follows:

Smear test: One hour (frequently less) after arrival of specimen. *Section test:* Three to 4 days (a hurried test can be done in a day, but will usually be unsatisfactory). *Animal inoculation test:* Ten days to 6 months.

After 30 days the probability of a positive result is small. Judging from 1003 specimens examined, correct diagnosis may be obtainable on the day of receipt of specimen in 90 per cent. of the cases; within 5 days, in about 92 per cent.; and at the end of 1 month practically all will be determined. Hasseltine (Public Health Reports, xxxiv, 2378, 1919).

ETIOLOGY.—Rabies attacks by preference the carnivora and in par-

ticular the dog and allied species, although human beings, cattle, horses, and swine are occasionally infected. It is transmitted from one animal to another by inoculation, usually from a bite, and is comparatively rare in countries and localities in which the muzzling of dogs is made compulsory.

In the dog the first symptoms appear from a few days to weeks after infection. The animal shows a change in disposition, becoming unusually irritable and snappish, although when left alone seeming dull and somnolent. Food is often refused and the animal eats or chews sticks, dirt, leaves, straw, etc. The dog becomes weak, tremulous, and unsteady on its legs in the paralytic or more common form, but in the "furious" form of the disease there is wild excitement, the animal running aimlessly about, barking, growling, and snapping at or biting anything in its way. In either case the creature soon becomes helpless, comatose, and dies. The toxic principle of rabies is widely diffused throughout the bodily tissues, and the disease has been produced by the experimental inoculation of portions of the nervous organs, salivary and mammary glands, suprarenal bodies, and pancreas. The virus is almost surely the product of a specific micro-organism, although bacteriologists have thus far been unsuccessful in attempts to isolate the pathogenic germ.

Occurrence in Man.—Rabies is always communicated to man by inoculation from the bites of animals suffering from the malady.

It is a disease now rarely seen in America and in Germany, but it is

somewhat more frequent in Russia and France. It was common in Europe some decades ago, but of recent years has been markedly less frequent. In the United States most of the cases during the last half-century have been reported from the Atlantic States. There was one outbreak of rabies in Ohio in 1810.

In the United States, during 1908, there were 111 deaths in human beings from hydrophobia reported from 30 States. Rabies was reported in the lower animals from at least 534 localities in 39 States and territories, including the District of Columbia. Evidence has also been secured of nearly 1500 persons who, on account of exposure to rabies, or presumably rabid animals, were obliged to take the Pasteur treatment. The disease is disseminated through the eastern three-fourths of the country, and seems to have been unknown during the past year only in the Rocky Mountain and Pacific Slope regions. Kerr and Stimpson (Jour. Amer. Med. Assoc., Sept. 25, 1909).

Several instances of the disease's having been communicated to man by the bites of skunks have been reported from western States.

Report of 18 persons bitten by skunks, in Arizona, during a period of two years; 5 of these persons were attacked with rabies, 5 died, and 13 were cured. The skunk is the most prolific endemic source of the propagation of rabies in Arizona; there is no such thing as a "hydrophobia skunk" *per se*, but all skunks are, like a few other animals, very susceptible to rabies; and no particular species is more susceptible than another. When a skunk, an animal nocturnal in habits, generally timid, attacks man or any other animal, and inflicts a bite, if the skunk is not killed and its bulb examined bacteriologically, it is better to accept this sudden change of disposition on the part of the skunk as *a priori* evidence of rabies, and

seek Pasteur treatment at once. C. E. Yount (So. Calif. Pract., March, 1910).

The cat and wolf may also communicate rabies by their bites, those of the wolf being especially virulent.

PATHOLOGY.—Rabies is, as above indicated, a specific toxemia of unknown bacterial origin.

The writer has made an important observation concerning the pathology of this mysterious disease, through his rare opportunity of securing autopsies on 4 persons who died during the period of treatment from some intercurrent disease (1 cerebral apoplexy, 1 pulmonary embolism, 2 delirium tremens). In all 4 cases it was found that the medulla, when emulsioned and injected subdurally, infected rabbits with rabies, showing the presence of active virus in the patient's nervous tissue; but apparently this virus was in an attenuated condition, since the incubation period in the inoculated rabbits was unusually long and the symptomatology that of the chronic or "consumptive" rabies. As but 1 person in about 10 of those bitten develops rabies, the writer's 4 consecutive positive findings do not represent latent infection, which would have manifested itself had the patients lived longer.

The writer believes that these observations indicate that persons bitten by rabid animals commonly have the virus reach the central nervous system, but that 9 times in 10 it is there destroyed, without causing symptoms, by the natural defensive mechanism which may be made more effective by the immunizing process of the **Pasteur treatment**; in other words, rabies-inoculated men usually develop a latent infection which is overcome without the symptoms of rabies appearing. The medulla of 3 persons who died without rabies shortly after the completion of a course of Pasteur treatment was found to be non-infectious for rabbits, indicating that the virus is destroyed under the influence

of the immunization. R. Paltauf (Wiener. klin. Woch., xxii, 1023, 1909).

It is difficult to infect rabbits and guinea-pigs either intramuscularly or subdurally with the saliva of dogs or guinea-pigs in the presymptomatic stage of rabies. In 1 case the saliva of a dog was infective three days before the animal showed symptoms. Even when the symptoms of rabies have manifested themselves it is still difficult to demonstrate the infectivity of saliva experimentally. This suggests that the bites of rabid dogs, even under optimum conditions for infection, may not infect because the saliva is not virulent. Suspensions of the salivary glands themselves are much more certainly infective under experimental conditions than the saliva derived from them. This is more especially the case for the submaxillary gland. Cruickshank (Indian Jour. Med. Research, Jan., 1914).

Some morbid anatomical changes in the nervous system are nearly always found, these being: dilatation of capillaries and small blood-vessels; marked congestion, with accumulation of lymphoid cells in the perivascular spaces; minute extravasations of blood, and some degenerative changes in the ganglion-cells. These alterations have been noted in the brain-cortex, medulla, and spinal cord; and by Gowers are alleged to be most pronounced in the medulla and the region of the nuclei of the pneumogastric, hypoglossal, and spinal accessory nerves, the leucocyte-like accumulation being here so prominent as to merit the term "miliary abscess." The pathological changes in the spinal cord are usually not well marked.

The pathologicoanatomical changes of asphyxia are often present, predominating in some cases or even being the only lesions found. The

mucous membrane of the fauces, pharynx, and larynx is often congested. The salivary glands have been found to show the changes of a mild inflammation, and a mild parenchymatous nephritis is often present. In dogs the stomach may contain straws, sticks, and other foreign matter eaten by the animal.

PROGNOSIS.—The hope of recovery from true well-marked rabies is very slight, death ensuing after a few days in almost every instance. During the past ten years excellent results in preventing the development of rabies in persons bitten by rabid animals have been obtained by the use of the preventive inoculations spoken of below.

Of 1608 cases treated at the New York Pasteur Institute previous to 1901, only 4 gave symptoms of disorders which could be traced directly to the treatment. Three had a partial paralysis of the lower limbs lasting from one to three weeks; 1 patient had facial paralysis lasting four weeks. All of these cases made uneventful recoveries. The antirabic vaccinations may cause a slight nervousness among neurasthenic and hysterical persons; but these disturbances are never serious and extremely rare. As to actual fatalities, records show that out of 1367 persons treated at the New York Pasteur Institute in the years 1890 to 1900, there were 9 deaths, a mortality of 0.65 per cent. In 1900, from January to September, at the New York Pasteur Institute, there were 921 cases treated and 2 deaths, representing a mortality of 0.1 per cent. From October 1, 1904, to October 1, 1906, there were 486 treatments with 1 death, representing a mortality of 0.206 per cent. Reports from other institutes show about the same results and finally a compilation of statistics from the reports of the Pasteur Institute of Paris for the last

twenty years shows that, out of 20,000 treatments, the mortality rate has been 0.25 per cent. P. B. Hadley (Providence Medical Journal, Jan., 1907).

TREATMENT.—As soon as a person is bitten by a supposedly rabid animal, a **ligature** should be placed upon the limb **above** the wound, the wound should be **disinfected** or, better still, thoroughly **cauterized by heat** or by **fuming nitric**, or **carbolic acid**, or in some cases may preferably be **excised**. The wound should not be closed, but **kept freely open and allowed to bleed** as much as it will.

Not all persons bitten by a rabid dog are infected. All animals known to be bitten, and all stray curs should be killed, and all dogs should be muzzled for eighteen months, on appearance of infection in the community. **Chloral** and **hyoscin**, in rather large doses, are the most trustworthy drugs. As regards the **Pasteur treatment**, each case is a law unto itself, in the matter of dose. Keene (Indiana Med. Jour., Feb., 1908).

The method followed at the El Paso Institute for the **cauterization** of wounds is as follows: Apply hot **bichloride**, 1:1000, or **boric acid solution** to the bitten part, or having soaked it in the same, dry the part; then apply, with a cotton-wool mop so shaped as to fit the crevices of the wounds, strong **carbolic acid solution**; immediately take another mop and apply **nitric acid**, whereupon a slight, explosive puff takes place; after this neutralize the nitric acid with a saturated **solution of bicarbonate of soda**, and wash off with **alcohol**, which arrests the action of the carbolic acid. Dress the wounds dry, retaining the compress in place by a bandage or adhesive plaster; in some cases collodion application may be used. If the slough or scab is sterile, as is often the case, further application to the wound should be avoided. The compress and ban-

dages may be removed when cleanliness necessitates. The wounds should be allowed to heal under aseptic scab unless complications, *i.e.*, infection, suppuration, etc., prevent. F. S. Cary (Jour. Amer. Med. Assoc., from New Mexico Med. Jour., Aug., 1911).

The wound should be **encouraged to bleed as freely** as possible for several minutes, then covered with a wad of cotton saturated with a mild **antiseptic solution**, such as a mixture of equal parts of **alcohol** and water with a small percentage of **iodine**; only such pressure should be used as is required to control the bleeding and protect the wound from further infection, and the cotton should be kept moist. When the area is small, the application of an **antiseptic wool-fat ointment** after the bleeding has been controlled may be of use. Where the wound does not bleed, a **suction pump** (similar to a cupping pump) should be applied, or, if there is none at hand, cautious **suction with the lips** may be made, any danger which might attend this being eliminated by holding in the mouth the alcohol, water, and iodine solution, while the lips are held over the infected area. When suction does not produce bleeding, the blood-capillaries have not been injured, and the poison is being carried in the lymph-channels; in these cases the antiseptic wool-fat ointment should be applied. After the wound has been dressed remedies may be given to relieve pain or induce general stimulation, if required. In the average case the writer gives 0.6 Gm. (10 grains) of **sodium salicylate** in combination with 0.05 Gm. ($\frac{5}{8}$ grain) of **caffeine sodium salicylate** every three to five hours. This is alternated with an **acid pepsin solution**, each dose containing 0.3 Gm. (5 grains). The effects of most poisons are much reduced by **lavage of the stomach** and **enteroclysis**. Lesser (Amer. Jour. of Surg., Aug., 1912).

At the time of onset of the first symptoms of hydrophobia these local

measures may properly again be resorted to should any evidence of irritation of the wound be present. The patient should be kept in a darkened room and free from any sources of irritation or annoyance. Restraint of any kind is not necessary, there being, contrary to common belief, little or no tendency on the part of the patient to injure others, and there is no danger of those in attendance contracting the disease. The patient should not be forced to make attempts at swallowing food or drink. Nutrient enemata should be employed, and large quantities of water be given by the rectum.

Local applications of cocaine to the fauces and pharynx are said to prevent spasm and enable the patient to swallow.

Case of rabies in which 10 c.c. ($2\frac{1}{2}$ drams) of 1 per cent. aqueous solution of phenol were injected into the subcutaneous tissues of the abdominal wall by means of an Ehrlich-Hata syringe at 8.30 P.M. on the day of the attack, which occurred five weeks after the dog-bite. At 9 P.M. 10 c.c. ($2\frac{1}{2}$ drams) of a 2 per cent. solution were injected similarly and repeated in an hour. At 11 P.M. there was a very perceptible improvement in the patient's condition. Hourly doses of the 1 per cent. solution were now resumed and administered until 8 A.M. A total of 11 doses, therefore, of the 1 per cent. solution and 2 doses of the 2 per cent. solution were administered, or, in the aggregate, an equivalent of $1\frac{1}{2}$ Gm. ($22\frac{1}{2}$ grains) of pure phenol. At 2 A.M., six hours after beginning treatment, the patient became somnolent, and when aroused was able to swallow readily. At this hour he was aroused for the first time by the insertion of the large-caliber needle. He stated that he now was conscious of his surroundings for the first time since early evening

and, when reminded of his previous actions and statements, denied any realization of them. He was catheterized at 2 A.M., about 8 ounces of urine being recovered, which contained a trace of albumin, but was otherwise normal. He did not require catheterization again, and subsequent specimens were normal. On the fourth day the patient was out of doors, and on the sixth day resumed work, there being no further sequela than a few days' prostration, which reasonably may be ascribed to excess muscular activity. There were no evidences, locally or generally, of any deleterious effects of the exhibition of the phenol. Haberlin (N. Y. State Jour. of Med., Sept., 1913).

During the violent spasms chloroform may be used by inhalation, and the administration of bromides and chloral by the mouth and of morphine hypodermically are followed by some amelioration of the acute symptoms. Curare, in $\frac{1}{10}$ - to $\frac{1}{4}$ - grain (0.006 to 0.016 Gm.) doses every half-hour until muscular relaxation occurs, is lauded by some. All such remedies are, however, merely palliative and exert no influence over the course of the disease.

Case of rabies in a girl, aged 13 years, in which, the customary sedative drugs proving ineffective and the prognosis being apparently hopeless, an intravenous injection of 0.3 Gm. (5 grains) of salvarsan was administered. Eight hours later pharyngeal and laryngeal spasm had entirely disappeared, slight dysphagia alone remaining.

On the following day the general hyperesthesia was likewise missing. The effect is believed by the author to have been a destruction of the living virus of the disease, without any influence on the toxins already elaborated, which remained to produce the secondary paralytic symptoms. R. Tonin (Il Policlinico, July 14, 1912).

Experiments showing that salvarsan, even in doses proportionately much larger than is possible in the clinic, had no appreciable effect on experimental rabies in 18 rabbits. Mejia (Semana Medica, Dec. 4, 1913).

PREVENTIVE INOCULATION.

—The work of Pasteur in developing the treatment of rabies by preventive inoculation constitutes by far the most important addition to our knowledge of the nature of the affection and the possibilities of its cure which has been made since the disease was first recognized. Pasteur found that the toxin in the spinal cords of rabbits which had been killed by rabies inoculation gradually lost its virulence if the cords were kept for some days under antiseptic precautions; so that after about two weeks the cord was no longer poisonous, inoculations from it failing to produce the disease. This fact offered then a method of gradually establishing an immunity, by inoculating the infected animal with cords which had, to a certain degree, lost their virulence through preservation in this way.

The production of artificial immunity is the now widely and successfully employed **Pasteur treatment** for rabies, persons bitten by mad dogs being carried through a series of inoculations with the spinal cords of rabbits. The inoculation is begun with cord which has been kept for 14 days; the second day cord 13 days old is employed; the third day 12-day-old cord, and so on until cord 5 days old is reached, when a new series of inoculations is commenced with the cord of the 9th or 10th day. In the "intensive" method the inoculation of the morning of the first

day is from cords 14 and 13 days old rubbed up together, cords of the 12th and 11th days being used the same evening, cords of the 10th and 9th days the following morning, and cords of the 8th and 7th the same afternoon. On the third day cord 6 days old is used; on the fourth day cord 5 days old, on the fifth day cord 4 days old, on the sixth day cord 3 days old; then a new series is begun with cord 5 days old. After from one to several weeks of this treatment the patient is regarded as immune, and the subsequent development of rabies is but slightly to be dreaded.

Of 14,000 persons inoculated in 8 years only 70 died of the disease, these fatal cases being chiefly persons who came for treatment months after the bite was received. There can be no doubt that the mortality from rabies has been enormously lessened by the use of this method of treatment.

The writer points out the great advantages of using **desiccated virus** in the immunization of those bitten by rabid dogs. It is safer than the ordinary method, in that the greater portion of the material injected is capable of immunizing without being infectious. It is economical both to the patient and to the laboratory, because it requires a much shorter time to administer a full treatment than most of the older methods. It is more convenient to prepare, as at one time enough material may be frozen, dried *in vacuo*, and sealed in glass tubes to last for from six to twelve months. Harris (Jour. of Infect. Dis., July, 1913).

From a study of personal cases and a review of the literature concerning similar ones the writer concludes that, in rare instances, some form of paralysis may be the direct result of

the Pasteur treatment. Concerning the basal cause of this paralysis there is a difference of opinion among neurologists. Some hold that it is a myelitis; others believe it is a neuritis. This complication is exceedingly uncommon. Thus out of 567 persons treated at the Hygienic Laboratory, paralysis occurred in only 2 instances, whereas a series of 7080 treatments investigated by Jones did not show 1 case. Recovery having eventually followed in nearly all cases so far reported, the fear of this complication should not deter one from administering antirabic serum whenever indicated. Hasseltine (Public Health Reports, Oct. 24, 1913).

The strict measures against rabies in Paris resulted in a drop from 846 cases in 1901 to 3 in 1913. The abandonment of their dogs by refugees and the absence of veterinarians, drawn into the war, have resulted in a recrudescence of rabies. In 1918 there were 411 rabid dogs killed in Paris, and 4 cases of rabies in man, and 350 persons taking the course of treatment at the Pasteur Institute at Paris. The ordinances in regard to keeping dogs muzzled and on a leash are not heeded now by the public, and in 1918 throughout France 1602 persons were bitten by rabid dogs, cats, cattle or sheep, with seven deaths, while 3142 cases of rabies in dogs were reported. Martel (Bull. de l'Acad. de Méd., Jan. 28, 1919).

A **rabies vaccine** is available for general use. In its preparation (Mulford), the spinal cord of a rabbit dead of rabies as a result of an injection of fixed virus (rabies virus known to kill within a fixed time) is removed under aseptic conditions. The cord is suspended over a layer of potassium hydroxide and kept at a temperature of 22° C. from one to eight days, and as a result the virus in the substance of the cord is gradually weakened or attenuated as the cord is dried. If suspended long

enough the virus may be entirely destroyed. The virus is strongest when the cord is fresh. Each day during the process of drying the strength decreases in direct proportion to the extent of the drying. It is with an emulsion of a portion of this dried cord that the first injection of the rabies vaccine is made. In the preparation of each injection of vaccine, a portion of a fresh cord in which the virus has been properly attenuated by drying is taken and emulsified by grinding under aseptic conditions with a weak solution of glycerin. It is kept and shipped in vacuum bottles which prevent deterioration during the time it takes to reach the applicant. Following the method of Pasteur, 25 doses, 3 at four-hour intervals, the first day, then 1 every day, are administered.

The vital preliminary in the **vaccine treatment** is the proper **cauterization** of the wound, and a second, and equally important step, is immediate **antirabic treatment**. By proper cauterization with **formalin**, it may be possible to reduce by one-half or more the infecting virus that may be present in a severe lacerating wound. This, followed by the vaccine treatment, should reduce mortality from hydrophobia to zero. The writer's method consists in the use of a virus that has been dialyzed in collodion sacs against running distilled water. Such a vaccine confers marked protection against infection, and, furthermore, when injected intracranially, will not produce the disease. Therefore, subcutaneous injections of the **dialyzed vaccine** are not only perfectly safe as a prophylactic, but confer the highest degree of immunity. A series of 12 successive daily injections of the standard dialyzed vaccine gives the same degree of immunity as obtained by the intensive form of Pasteur treatment,

which consists of twenty-one days of injection. Over 800 persons bitten by animals suspected of having rabies were treated by this method. Of this number, 62 per cent. were bitten by animals proved by laboratory examination to have been rabid, and in every case the treatment was successful. Cumming (*Jour. of Infect. Dis.*, Jan., 1914).

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RACHITIS. See BONES, DISEASES OF.

RADIUM. See X-RAY AND RADIUM.

RAILWAY SPINE. See VASCULAR SYSTEM, DISORDERS OF.

RAREFIED AIR, DISEASES DUE TO.—ALTITUDE SICKNESS; MOUNTAIN SICKNESS; BALLOON SICKNESS.—DEFINITION.—The term "altitude sickness" better than any would describe a series of symptoms resulting from diminution of the atmospheric pressure when high altitudes are reached, whether these are reached by climbing or during aerial navigation. See also AVIATOR'S SICKNESS, second volume.

SYMPTOMS.—Altitude sickness affects persons unaccustomed to existence in elevated countries, when, according to Liebig, the altitude exceeds 10,000 feet. The symptoms are: quick pulse, rapid breathing, sometimes approaching the Cheyne-Stokes type; headache, an elevation of temperature of one or two degrees F., and feelings of constriction and weariness; in higher degree, giddiness, nausea, loss of strength in the legs, finally engorgement of the venous system and the escape of blood from the superficial capillaries. When very high altitudes are reached, hemorrhages from the nose, mouth, and ears occur in addition to the more serious symptoms described, and death may occur. The red corpuscles and the hemoglobin may be markedly reduced and there is gradual loss of weight for a time.

After a few days, usually five, the body seems to have adjusted itself in part to

its surroundings and the symptoms then begin to abate. If the altitude is not too great, the time comes when no abnormal symptom is experienced.

[The summit of Pike's Peak, Colorado, which is 14,109 feet above sea level, and where the barometric pressure is about 18 inches (457 mm.), affords a fair idea of the effects of such levels on man. Four well-known scientists who ascended the mountain—Doctor Douglas and Doctor Haldane, of Oxford; Doctor Henderson, of Yale, and Doctor Schneider, of Colorado College—have published ("Proceedings of the Royal Society," Series B, April 12, 1912) preliminary observations and conclusions which suggest clearly that the aëroplanist would do well to remain closer to earth. While they found that after two, three or four days on the summit of Pike's Peak very distinct signs of acclimatization occurred, their faces and lips became blue, and they suffered from nausea, intestinal disturbance, headache, fainting in some instances, periodic breathing, besides great orthopnea on exertion, or on holding the breath for a few seconds.

As to its bearing upon aerial navigation, an acclimatization would be out of the question with the aëroplanist; prophylaxis would simply impose, in time of war, closer proximity to earth and its consequences. The comfort which the pilot would need to carry on his nerve-racking steering with safety would, in fact, hardly be procured above 6000 or 7000 feet. C. E. DE M. S.]

PATHOLOGY.—The increased frequency of respiration at higher levels is involuntary, and the respirations become more shallow to compensate for it; hence the lungs become more contracted, and they accommodate less blood. Venous stasis and deficient oxidation then ensue. Though less oxygen reaches the lungs when rarefied air is breathed, causing increased distress, this is not the main cause of the disorder. A person must be accustomed to the atmosphere of higher levels before a normal respiration occurs under the altered condition of atmospheric pressure. Mosso has suggested that excessive exit of carbonic acid from the blood causes the disorder by reducing too greatly the

proportion of this gas in the tissues. The deficient oxidation which necessarily attends the rarefaction in high altitudes has also been incriminated, while others again attribute the disease to mechanical disturbances of the peripheral circulation. The main feature of the process is probably, in addition to the latter cause, deficiency of the constituents of hemoglobin which enable the latter to take up oxygen from air in the alveola.

The writer's experience near the summit of Mont Blanc led him to ascribe more influence to the mechanical hindrance to circulation, at high altitudes, in the causation of mountain sickness, than to the most feasible of hitherto suggested origins, that of diminished oxygen. In fact, he took up with him a supply of compressed oxygen, but found it of no service in combating the distressing symptoms endured. The main source of circulatory disturbance is to be found in distention of the peripheral veins and stagnation in the portal system. Gugliel-Minetti (*Progrès méd.*, Jan. 26; Feb. 2, 1901).

The writer disagrees with Mosso that the symptoms of mountain sickness are due to diminution of the carbonic acid in the blood; as a rule, they can be best relieved not by the inhalation of carbonic acid gas, but by the inhalation of pure oxygen. Experiments with the flask and rubber bag upon living rabbits showed that, as the pressure of the external air is diminished, the intrapleural pressure is increased. The explanation of this curious fact is that, as the external pressure is diminished, the quantity of air in the pleural cavity is increased. As, however, the diaphragm follows the lung upward, the space is not altered, and, therefore, the pressure upon the lung is greater. When the atmospheric pressure is increased, then the quantity of air in the pleural cavity is diminished and the reverse occurs. E. Aron (*Virchow's Archiv*, Bd. clxx, H. 2, 1902).

TREATMENT.—Oxygen inhalations may be tried, but they have not been found

of much aid. Mantegazza, who introduced the use of coca in medicine, informed the writer that he found that **chewing coca-leaves** prevented mountain sickness. The danger of acquiring the cocaine habit through their use is not great owing to the infinitesimal quantity of this principle they contain, but its possibility should be borne in mind.

Douglas, Haldane, and Henderson ascribe the disease to deficient secretory activity of the alveolar epithelium. This coincides with the observation of Buckmaster and Gardner that the inhalation of oxygen does not materially augment the quantity of this gas in the blood. In other words, a substance or secretion is required to enable the blood to take up oxygen. Sajous has shown that this secretion is that of the adrenals. He therefore advocates for aëroplanists, the use of desiccated **adrenal gland** or, better, **pituitary gland**, which is more durable in its effects. By increasing the capacity of the blood to take up oxygen, the main untoward effects of high altitudes are in a measure counteracted. S.

RAYNAUD'S DISEASE. See VASCULAR SYSTEM, DISORDERS OF.

RECTUM AND ANUS, DISEASES OF. (See also HEMORRHOIDS, volume v.)

IRRITABLE ULCER OF THE RECTUM, OR FISSURE OF THE ANUS.

DEFINITION.—Primarily, a superficial breach of the mucous membrane in the anal region, which, if unhealed, finally results in the formation of an ulcer of the bowel. This may involve both the mucous and submucous coats, and give rise to a spasmodic contraction of the parts and paroxysmal pain.

SYMPTOMS.—In the early stages the symptoms are not usually marked or even severe. They are generally experienced during defecation, when at some point or other there will be

an uneasy sensation, consisting of an itching, pricking, slight smarting, or a feeling of heat about the circumference of the anus. As the disease progresses the discomfort attending the movements of the bowel is greatly augmented; there may be severe pain, of a burning or lancinating character. This is followed by throbbing and excruciating aching, attended by violent spasmodic contraction of the sphincter muscles, continuing from half an hour to half the day. While the pain lasts the patient is usually incapacitated for work. The slightest movement sometimes greatly aggravates the suffering.

After an indefinite period the pain subsides or entirely disappears, the patient feeling fairly comfortable or even perfectly well, and to all outward appearance he would continue so were it not for the knowledge that the subsequent passage of fecal matter will bring with it a recurrence of agony. In consequence of this dread, the act of defecation is postponed as long as possible, with the result that when the evacuation does take place the pain is greatly increased. The feces, when solid, will be passed streaked with mucus and sometimes also with blood, and when more soft may be flattened and tape-like, due to the incomplete relaxation of the sphincters. Attention should be called here to a point which has a bearing upon the diagnosis of rectal lesions, to wit, that the tape-like and flattened appearance of the stools is rarely an evidence of stricture of the bowel. It may arise from any spasmodic muscular contraction, such as due to irritation from the presence of a polypus, fissure, etc. Special mention is made of this fact, because

the profession has been led to believe otherwise by reading the older textbooks, etc.

When a fissure is of long duration, the general health becomes greatly impaired as a result of the constant pain, the constipation, and the frequent resort to narcotics (always a mistake, as their use constipates and thereby aggravates the trouble), and the patient is liable to fall into a state of melancholy and extreme irritability. The countenance, expressive of pain, grows careworn and sallow; the appetite is poor; and there is more or less emaciation, associated with the general appearance of a person suffering from serious organic disease. Flatulence generally attends severe cases; it is not only troublesome, but painful, the passage of gas being almost certain to bring on a paroxysm of pain.

The ulcer is usually located just within the anus, beginning at the mucocutaneous junction (Hilton's line), and extending upward toward the rectum for a distance seldom exceeding half an inch. It may occupy any portion of the circumference of the anal region, but its usual site is at its posterior, or coccygeal, side. Although this lesion is usually solitary, we sometimes find it multiple, especially when of syphilitic origin.

DIAGNOSIS.—The signs are so characteristic of the lesion that it is almost impossible for a diagnostic error to be made. The peculiar nature of the pain, the time of its occurrence (either during or some time after an evacuation of the bowels), its continued increase until it becomes unbearable, and its gradual decline and entire subsidence until the next

evacuation clearly point to irritable ulcer of the anus, and in most instances should be sufficient to establish a diagnosis. Yet in numerous well-authenticated cases mistakes have been made and patients suffering from this disease have been treated for neuralgia, uterine or vesical affections, stricture, and even hemorrhoids.

This disease is very readily distinguishable from neuralgia by the absence in the latter of any breach of the surface or of any other disease of the mucous membrane of the rectum; by the entire want of connection between the pain and the alvine discharge, and by the constant suffering. In neuralgia the pain caused by pressure with the finger in the anus is not confined to one spot, as it is in fissure, but all parts of the bowel are alike tender.

The symptoms of anal fissure often simulate closely those of uterine disease and bladder affections. Spasm of the sphincters in these cases may also simulate stricture, but a thorough examination will dispel all uncertainty.

Frequently uterine disorders or hemorrhoids are associated with the fissure; in this event the case is treated for either one or the other of the first two complaints, the presence of the other lesion being unsuspected and consequently neglected. In all such instances a careful inspection of all the parts will at once prevent all errors. Small polypoid growths are often found at the upper portion of the fissure and unless removed will prevent successful treatment.

[Fissure of the rectum is one of the causes of dyspareunia, which may be diagnosed as vaginismus. The cure of

the fissure will be quickly followed by relief of the symptoms. C. B. KELSEY, Assoc. Ed., Annual, 1892.]

ETIOLOGY AND PATHOLOGY.

—Fissure is a disease of adult life, and is said to be more common among women than among men. Very young children, however, are not exempt, and my experience would lead me to suspect that it often exists in many such cases without being discovered. The intense suffering due to the structural arrangement of the termination of the bowel, especially its nerve-supply. As is well known, the outlet of the intestine is closed by two sphincter muscles, the external being immediately beneath and parallel to the skin surrounding the margin of the anus. On the inner side, or rectal surface, the muscles are in contact, the line of union corresponding accurately with the junction of the skin and the mucous membrane. In most cases this junction of the sphincters is marked by a line of condensed connective tissue, and is known as "Hilton's white line." Attention is drawn to this term because of an important anatomical fact, which Hilton has pointed out in this connection: to wit, that it is the point of exit of the nerves, principally branches of the pudic, which descend between the two sphincter muscles, becoming superficial in this situation, and are there distributed to the papillæ and mucous membrane of the anus. These nerves are very numerous, and account for the extreme sensitiveness of the part and also for its very abundant reflex communications with other organs (Andrews, "Rectal and Anal Surgery," second edition, Chicago, p. 69). The exposure of one of their filaments, either in the floor or at

the edge of the ulcer, is an essential condition of the existence of irritable ulcer. The upper portion of the rectum possesses very little sensibility, as the chief nerve-supply of the organ is at its termination and around the anus; hence it is that such grave diseases as cancer or ulceration may exist in the higher portions of the bowel and not manifest their presence by pain.

Irritable ulcers may arise from a variety of causes, such as atony of the muscular coat of the rectum, or other conditions leading to constipation. In these cases the bowel becomes impacted with hardened feces, which when discharged overstretch the delicate mucous membrane, and thus, either by irritation or by direct abrasion, the ulcer is formed. The late William Bodenhamer, in his masterly treatise ("Anal Fissure," 1868, New York) states that, in some cases of constipation, while the diaphragm and other abdominal muscles act with considerable energy, the anal sphincters remain more or less contracted, and yield but slowly, so that the indurated feces contuse and abrade the surface of one or more points of the mucous membrane, which abrasions, if they do not heal, lay the foundation of the disease.

Irritable ulcers sometimes result from the excoriations produced by vitiated and acrid discharges, such as occur in dysentery, chronic diarrhea, cholera, leucorrhea, etc. Hemorrhoids are frequently a predisposing cause and a complication. They narrow the outlet of the bowel, and through the successive inflammatory attacks to which they are subject the neighboring tissue loses its elasticity, is rendered brittle, and is much more easily lacerated.

Polypi are not uncommon causes; they are usually situated at the upper or internal end of the ulcer.

PROGNOSIS.—With proper treatment irritable ulcer can be promptly cured and practically without risk.

TREATMENT.—The first step is to establish regularity in the intestinal functions. **Enemas or mild aperients** should be employed and the **diet regulated**, the use of bland and unirritating food being enjoined. **Phenolphthalein**, in doses of 4 grains (0.26 Gm.) at bedtime, is a satisfactory aperient, as it does not gripe and produces a soft, mushy stool. All drastic purges should be avoided. To obtain a daily evacuation of the bowels and to render the movement as painless as possible, a 10-grain (0.65 Gm.) **suppository of iodoform** is to be used, followed in one-half hour by an **enema of rich flaxseed-tea**, from half a pint to a pint (250 to 500 c.c.). This should be administered every evening before retiring, the patient being then able to assume the recumbent posture, which, combined with the rest, affords the most relief from subsequent pain. Immediately after an evacuation of the bowels is obtained, another 10-grain (0.65 Gm.) **iodoform suppository** is to be inserted into the rectum, followed by another containing 3 grains (0.2 Gm.) of **ichthyol**. The iodoform suppository relieves the pain, and is far preferable to opiates, which tend to constipate. The ichthyol suppository allays the inflammatory condition usually present. If the enema should prove ineffectual, another should be employed in half an hour.

Palliative Measures.—Palliative treatment will meet with success in a certain proportion of cases, but only

when there is no great hypertrophy of the sphincter muscles. The Allinghams state that the curability of this lesion does not depend upon the length of time during which it has existed, but rather upon the pathological changes it has wrought. They have cured fissures of months' standing by means of local applications, where the ulcers were uncomplicated with polypi or hemorrhoids, and where there was not very marked spasm or thickening of the sphincters.

Rigid cleanliness is essential. The anus and the adjacent portions should be carefully sponged night and morning and after each stool with hot or cold water, the temperature being regulated to suit the patient's comfort.

Whenever a fissure is complicated by the presence of a "sentinel pile," no local application will prove effective unless the **pile is removed**. This may be readily accomplished by injecting a few drops of a quarter of a 1 per cent. cocaine solution about its base and snipping it off at its base with a pair of curved scissors.

Before applying remedies, the ulcer should be exposed and anesthetized with a 4 per cent. solution of the **hydrochlorate of cocaine**, using a camel's-hair pencil to make the application, and repeated once or twice, at intervals of three or four minutes.

Among the remedies used, the following may be mentioned: **Nitrate of silver, acid nitrate of mercury; fuming nitric acid; carbolic acid; sulphate of copper; the actual cautery.** L. J. Hirschman, of Detroit, Mich., advocates and has employed with considerable success a 5 to 10 per cent. ointment of **scarlet red** every third day and finds it an excellent

stimulant to the formation of new epithelium. In my hands, the **silver nitrate** has proven most satisfactory. It lessens or obviates the nervous irritation underlying the spasmodic contractions of the sphincters; it shields the raw and exposed mucous surface by forming an insoluble silver albuminate, and destroys the hard and callous edges of the ulcer.

To attain the best results a strong solution, 240 grains (16 Gm.) to the ounce (30 c.c.) of distilled water, should be used once in two or three days, according to circumstances. It may be applied by means of cotton attached to a silver applicator or to a piece of wood, separating the margins of the anal orifice with the thumb and index finger of the left hand. The solution is to be applied to the ulcer only; a few drops are all that will be required. If thorough local anesthesia has been obtained the drug produces little, if any, suffering. After each application and daily thereafter until the ulcer is healed, a 25 per cent. **ichthyol ointment** should be applied to the ulcer. This can be used upon a probe on which a dossil of cotton is attached which is thoroughly saturated with the ointment. This is inserted in the anus, immediately over the site of the ulcer and left *in situ*.

When this plan of treatment fails, resort to operative measures is indicated.

Operative Treatment.—There are three methods worthy of consideration in this connection: (1) *forcible dilatation*; (2) *incision*; (3) *a combination of these two procedures*, to wit: *forcible dilatation and incision*.

FORCIBLE DILATATION.—This is the operation recommended by Récamier,

Van Buren, and others. It consists in introducing the two thumbs into the bowel back to back, and then forcibly separating them until the sides of the bowel are stretched as far out as the tuberosities of the ischii. It is essential to place the ball of one thumb over the fissure, and that of the other directly opposite to it, in order to prevent the fissure from being torn through and the mucous membrane being stripped off. This procedure should always be done with the patient thoroughly under the influence of an anesthetic, and it should occupy about five minutes.

The operation is a perfectly safe one, but as it is no less severe than the operation by incision, and as in some cases it fails to effect a cure, there is no advantage in adopting it instead. Permanent incontinence of feces has ensued from undue forcible dilatation, two such cases being reported by J. P. Tuttle.

INCISION.—The incision should be made through the base of the ulcer and a little longer than the fissure itself, so as to sever all the exposed nerve-filaments. The cut should divide the muscular fibers along the floor of the ulcer. When the ulcer is directly over the anterior or posterior commissure, it is much better to make a V-shaped incision at either of these points, as suggested by Samuel T. Earle, owing to the decussation of the muscular fibers at the former site, and of their tendinous prolongation to unite with the coccyx at the posterior commissure.

In a fair proportion of cases this operation will meet with success, but it is not so certain to result successfully as the operation next to be described. It has the advantage over

the other operations, however, of being nearly or entirely painless, under local cocaine anesthesia, by a hypodermic use of a $\frac{1}{4}$ of 1 per cent. solution, the injection being made directly beneath the ulcer and about its sides, using sufficient to produce the desired effect, as there is no danger from such a weak solution. When, therefore, general anesthesia is contraindicated or is refused by the patient, this method is worthy of a trial.

DILATATION AND INCISION.—This operation is a radical and unfailing cure. The bowels should be emptied by a dose of 10 grains (0.65 Gm.) of blue mass and the use of an enema of plain normal saline solution, after which, under general anesthesia, the sphincters should be dilated in the manner previously described. A straight, blunt-pointed bistoury should then be drawn lightly across the surface, making a cut extending about an eighth of an inch above and below the limits of the ulcer and about a sixteenth of an inch in depth. Usually it is a good plan to curette the entire floor of the ulcer in addition, and with curved scissors trim away any overhanging edges as well as remove any polypi present—even though they be small, as the presence of a polypus will usually prevent a permanent cure.

The after-treatment consists in keeping the patient in the recumbent position for twenty-four hours, and in cleansing the parts with creolin solution (a teaspoonful to a pint of water), and the application of a 25 per cent. ichthyol ointment to the wound, not oftener than once a day. In a week or so, the parts will be perfectly well.

FISTULA IN ANO.

DEFINITION.—An unnatural channel leading from a cutaneous or mucous surface to another free surface or terminating blindly in the substance of an organ or part.

VARIETIES.—For all practical purposes we may divide fistulæ into the following four forms: (1) the *complete*, in which there are two openings, one in the rectum and one on the skin more or less remote from the anus; (2) the *incomplete internal*, in which there is a communication with the cavity of the rectum by means of an opening in the mucous membrane, but none with the external surface of the body; (3) the *incomplete external*, in which there is an external opening through the skin, but no communication with the bowel; and (4) the *complicated*, or so-called complex, variety, in which there are many sinuses and numerous external openings. Some of these tracks run outward; some extend up the bowel beneath the mucous membrane; while others travel around the bowel and open in the other buttock, giving rise to the variety known as the horseshoe fistula. The second and third varieties named are frequently spoken of as blind fistulæ.

These classifications may be further subdivided, according to the character of the tissues involved, as *subcutaneous*, *submucous*, *submuscular*, and *subaponeurotic*. They may be *non-specific*, and due to infection by ordinary pus-organisms; or, specific when *specific* causes occur, such as tuberculosis, syphilis, and carcinoma.

According to the late J. P. Tuttle, the proportionate frequency of the different varieties may be said to be:

of those that are complete, about 70 per cent.; of blind external, about 20 per cent., and of blind internal, 10 per cent. of the recorded cases.

SYMPTOMS.—Occasionally there is considerable pain, but only when a track is blocked and pus has collected therein; more frequently only a feeling of uneasiness is experienced about the anus. When a fistula originates, as it commonly does, from a pre-existing abscess, there is a sensation of weight about the anus, with swelling of the integument, considerable tenderness upon pressure, pain in defecation, and more or less constitutional disturbance associated with rigors.

The chief discomfort is the discharge, which varies in quantity and may be purulent or mucopurulent. This discharge occurs from the sinus so long as it remains unhealed, soiling the linen and making the patient moist and uncomfortable. It often produces an excoriation of the nates. The discharge is not of itself sufficient to be a source of great exhaustion and does not interfere with ordinary occupations, so that many patients have had fistula for a considerable length of time without being conscious of any serious ailment. The escape of flatus and mucus from the sinus in cases of complete fistula will often prove a source of annoyance, as will also the passage of feculent matter, which may be expelled through the sinus should the track be large and patulous. An attack of secondary suppuration is always liable to complicate a fistula, and is usually due to a stoppage of the sinus by small particles of feces or by an exuberant growth of the granulation. Such a sequel, of course,

is attended with pain, until a new opening forms or one is made by the surgeon. In some cases the original fistulous track becomes re-established. Patients of neurotic habit often suffer mentally and from general weakness. As in other affections of the rectum, various reflex pains are experienced, which may be referred to the back, to the loins, and to the lower portion of the abdomen. When such pains extend down the leg and to the foot, they are liable to be attributed to sciatica, unless the history of the case is carefully studied and a critical examination is made.

DIAGNOSIS.—Prior to the examination of the rectum the bowels should be emptied by an enema. This procedure not only renders the exploration of the parts easier and cleaner, but also, in women especially, serves to quiet the patient's fears of any untoward accident occurring; and therefore facilitates the thoroughness of the surgeon's examination by securing the co-operation of the patient, as in extruding the parts, etc.

The patient should be placed in a recumbent position on a table or an examining chair, with the legs well drawn up toward the abdomen, and the buttocks brought to the edge of the couch. If the external orifice of the sinus is prominent, or if there is a sentinel granulation, the outlet of the fistula will be obvious; but when it is small and located between folds of the skin its situation may be demonstrated by making pressure with the tip of the finger in the suspected locality, which will usually cause a little drop of matter to exude. The site of a fistula may often be detected by feeling gently all around the anus

with the forefinger and finding an induration suggesting a pipe-stem beneath the skin. A flexible silver probe should now be passed along the fistulous track. In doing this considerable care is requisite and the utmost gentleness should be observed, the probe being directed by its own weight through the sinus and not forcibly. If it does not pass easily, it may be bent and "coaxed" along the channel. In the majority of instances it will pass directly into the bowel, and usually the internal opening will be found low down in the anal outlet just between the two sphincter muscles. When the probe has passed as far as it will go without the use of any force, the finger is introduced into the rectum. When it comes in contact with the free end of the probe it demonstrates the presence of a complete fistulous track. In other cases the mucous membrane is felt to intervene between the finger and the probe; in such cases the internal opening generally exists, but it is difficult to discover—sometimes because the examiner searches too high in the bowel. Palpation with the sensitive tip of the finger will often render the presence of the inner orifice obvious by coming in contact with an indurated mass of tissue. If such a spot be felt, the finger should be placed upon it and the probe passed toward the finger. There may not be an internal opening; if not, the operator should ascertain how near the probe comes to the surface of the bowel. If a doubt still exists as to the completeness of the track, any one of a variety of specula may be introduced into the rectum, but not until the outer orifice of the sinus is injected with a solution of iodine or

creolin. J. Rawson Pennington, of Chicago, advises methylene blue, and A. J. Zoble, of San Francisco, employs a saturated solution of potassium permanganate. If there be an internal opening, the appearance of the fluid within the bowel will set the question at rest. If a speculum be first introduced it may serve to, and often does, close these sinuses, so as to prevent their fluid from passing through. Should the inner opening not be discovered by these methods the case must be looked upon as one of external rectal fistula.

The injection of the potassium permanganate and methylene blue prior to any operation upon a fistula may render the track or tracks more obvious, and thus materially assist the operator in locating them.

When there are numerous external openings it is necessary to probe all of them so as to determine whether they are connected and the direction which they take. Sometimes more than one internal orifice exists.

The presence of an incomplete rectal fistula is more difficult to determine than the other varieties of this lesion which have just been considered. It is the most painful form, but fortunately it is of infrequent occurrence. Its orifice may be located anywhere in the rectum, but it is generally found between the internal and the external sphincters. According to the Allinghams, the circumference of this opening is often as large as an English three-penny piece, its edges being sometimes indurated, at other times undermined. The feces when liquid pass into the sinus and create great suffering—a burning pain often lasting all day after the bowels have acted. In this variety of fistula the

feces are coated with more or less pus or blood and a boggy swelling is noticed at some portion of the circumference of the anus. A peculiar feature of this swelling is often noted, viz., its presence one day and its disappearance in a day or two, followed by an increased discharge of pus from the bowel. This is explainable by the closure of the outlet of the fistula caused either by a plug of feces or as a result of inflammatory swelling which allows the collection of a quantity of pus and the consequent formation of the boggy tumor. The swelling disappears upon the re-establishment of the communication between the bowel and the sinus, and is attended by a profuse discharge of matter previously mentioned. This phenomenon is repeated over and over again, and, as a rule, is a pretty positive indication as to the nature of the disease. In some cases of blind internal fistula, if the orifice can be felt or if it can be seen through a speculum, a bent probe may be introduced into it and made to protrude near to the cutaneous surface of the body, where its point can be felt.

Fistulæ frequently coexist with other rectal diseases; it is, therefore, important that an examination should be carefully made, so as to exclude such lesions as stricture, malignant or benign; hemorrhoids, tumors, etc. A thorough physical examination of the chest should also be made, to ascertain the presence or absence of phthisis, which so frequently complicates fistula in ano.

Serious kidney disease should be excluded before recommending operation, for obvious reasons. In cases of caries of the vertebræ, of the sacrum, or of the pelvis, fistulous tracks

may form and simulate anal fistula. In such instances a careful investigation will reveal the true origin of the trouble and show that the case is not one of ordinary anal fistula. In this connection attention should be called to the work of Dr. Emil G. Beck, of Chicago, in the employment of bismuth in the diagnosis and treatment of fistulous breaks, tuberculous sinuses and abscess cavities, by which means it is possible to skiagraph the entire track. A number of cures have been reported from the adoption of Dr. Beck's suggestion to use:—

℞ *Bismuth subnitrate* . ℥j (30 Gm.).
White wax ℥iss (5.9 Gm.).
Soft paraffin ℥i¼ (5 Gm.).
Vaseline ℥ij (60 Gm.).

Mix while boiling.

This formula is injected into a sinus and allowed to remain and harden.

For diagnostic purposes Dr. Beck used:—

℞ *Bismuth subnitrate*
 (arsenic free) ... ℥j (30 Gm.).
Vaseline ℥iss (5.9 Gm.).

Mix while boiling.

He directs that the fistula be dried out as thoroughly as possible prior to using the paste, then a glass syringe loaded with the paste is tightly pressed against the fistulous opening and the contents slowly injected into the sinus until the patient complains of pressure. The treatment is continued as long as a discharge of pus recurs. I have not had the favorable results depicted by Dr. Beck and his advocates for this method, and numerous cases of nitrite poisoning have occurred from its employment.

ETIOLOGY.—Fistula in ano, which is not due to ulceration and

perforation of the rectal wall from within, is the result of a previous abscess, except in those rare instances, due to penetrating wounds, which extend from the exterior into the rectal cavity or adjacent parts, such as gunshot or bayonet wounds, etc. Such an abscess forms in the ischio-rectal fossa, and although opened early by a free incision, even before the cavity becomes distended with pus, it frequently fails to heal. It may fill up and contract to a certain extent, but it does not become obliterated; a narrow track remains, which constitutes the fistula.

There are several reasons why rectal abscesses so frequently degenerate into fistulæ. One is that, owing to an internal opening communicating with the bowel, small particles of fecal matter find their way into the sinus, and, acting as foreign bodies, prevent the healing; another, that, owing to the frequent unusual movement of the parts, sufficient rest is not obtained for the completion of the reparative process; and, finally, the vessels near the rectum, not being well supported and the veins having no valves, there is a decided tendency to stasis, which is unfavorable to granulation.

According to Harrison Cripps, the surface of the fistulous track is lined with a smooth, gelatinous membrane, which, when examined under the microscope, is found to consist of granulation tissue exactly analogous to that which lines the interior of a chronic abscess. The leucocytes constituting the outer wall of this membrane are but loosely adherent, and, constantly becoming free, they form the chief part of the pus which drains from the fistula.

This disease is commonly met with during middle life, but it is by no means restricted to this period. The Allinghams state that they have operated upon an infant in arms and upon persons over eighty years old. Statistics prove that this disorder occurs much more frequently in men than in women. This fact depends, no doubt, on the former being more exposed to accidents likely to produce perirectal abscesses; that they pay less attention to their personal cleanliness, and that they are more liable to go to excess in eating and drinking.

COURSE AND PROGNOSIS.—

This disease, untreated, has a tendency to progress. The longer its duration, the more likely it is to become tortuous and complicated. Hence, the earlier the patient submits to treatment, the more favorable will be the prognosis. Again, the time and extent of the treatment necessary to effect a permanent cure will be correspondingly diminished.

TREATMENT. — Preventive.—

When a patient presents the symptoms of a threatened abscess in the vicinity of the rectum, he should be directed to go to bed, or at least to avoid all undue exercise; the bowels should be thoroughly evacuated, preferably by the use of a **saline**; the diet should be **nutritious**; and, if the case be seen early, **hot fomentations and poultices** may be applied to the parts. The early adoption of these measures may abort the threatened abscess, but very little encouragement can be given the patient.

If there be reason to suspect that pus has formed or is forming, it will be necessary to make a free **incision** into the center of the affected site

with a sharp, curved bistoury, if the trouble is superficial, or, if it is deep, with a narrow, straight knife. The earlier this is done, and the freer the opening is made, the less liability there will be of a fistula resulting. When pus is present and is deeply situated, the evacuation of the abscess will be aided by the introduction of the forefinger into the bowel; the swelling may thus be pushed forward, rendered tense, and made more apparent.

In opening these abscesses, local anesthesia may be used, but **ether** or **nitrous oxide gas** is preferable. The patient should lie on the side upon which the threatened abscess is situated; the upper leg should be bent forward upon the abdomen. When pus is present the operator should stand out of the line of its exit, for when the cavity is opened the pus often squirts out a considerable distance. After the matter has been discharged, the forefinger should be introduced into the abscess cavity for the purpose of breaking down any secondary cavities or loculi that may exist. If a general anesthetic has been employed, the wall of the abscess should be thoroughly curetted. When this has been accomplished the abscess should be washed with **bichloride of mercury solution, 1:4000**, or, **creolin solution**,—a teaspoonful to a pint,—after which a rubber drainage-tube should be inserted to allow free drainage; or a piece of iodoform gauze should be packed into the incision to prevent its closing too rapidly. Careful daily attention should be paid to the wound while the cavity of the abscess is contracting, as it is important to maintain a free and dependent outlet for the dis-

charge that may continue to be secreted. All packing and overdistention of the cavity should be avoided after the first dressing, *i.e.*, that employed following operation. If a drainage-tube be used, it should be shortened from day to day as the wall of the abscess contracts.

After an operation for rectal abscess the patient should be kept quiet for several days, but not necessarily confined to bed, as drainage is better when the patient is allowed to move around. If care be taken, both with the subsequent drainage and in keeping the orifice open, the parts may heal without the formation of a fistula.

Palliative treatment will be required where there is a positive refusal on the part of the patient to submit to an operation, and in persons whose general health is broken down and in whom the reparative powers are inadequate. Chronic alcoholism, albuminuria, diabetes, malignant disease, etc., are conditions in which operative measures may be attended with risk, and in which it may be advisable to resort to palliative measures. Phthisis is not a contraindication to operative measures, unless the fistula be a tubercular one. Such cases are rare, possibly one out of a thousand, the diagnosis being made by finding the tubercular bacilli in the discharge. There is a vast difference between a fistula occurring in the tubercular subject and a tubercular fistula. The rule usually followed is to operate in those cases of tubercular subjects in which the disease is quiescent, but to avoid such interference if the lung mischief is active.

Incomplete external fistulæ, and even complete fistulæ of somewhat

recent origin and not extensively indurated, may be cured by non-operative measures; but such treatment requires constant attention on the part of the practitioner as well as a willingness on the part of the patient to give sufficient time to the treatment. Even under such circumstances the process of repair is slow, and in many cases the result will not be perfectly satisfactory. It is true that fistulæ sometimes recover spontaneously or are cured by simple means, such as the mere passage of a probe used in examining the fistulous track; but instances of this kind are rare. In certain selected cases of fistula (very limited in number), a cure may be effected by stimulating the sinus and allowing free drainage. This is done so as to avoid the use of the knife, when possible. To obtain satisfactory results the following indications should be borne in mind: That the external orifice should be kept perfectly free; that the sinus should be kept clean, so as to prevent putrefactive changes, and that an effort be made to excite a healthy action in the fistulous channel. To meet the first indication, it is necessary to dilate the outer opening of the fistula with sponge or sea-tangle tents, or with Lee's antiseptic slippery-elm tents. The latter are made of selected slippery-elm bark and are compressed under high pressure. Owing to their non-irritating and demulcent properties, they are to be preferred. The second indication (that the sinus be kept clean, so as to prevent putrefactive changes) is best carried out by the use of bichloride of mercury solutions 1:4000, or creolin solutions, a teaspoonful to a pint (500 c.c.) of water. Such solu-

tions are injected into the sinus by means of a long, flexible silver cannula attached to an hypodermic syringe. The third indication (to excite a healthy action in the sinus) can be met in one of a number of ways. Anesthesia of the channel with an injection into the sinus of a 2 per cent. solution of **cocaine**, using the same syringe and cannula that are used for cleansing the fistula, is desirable. If the wall of the sinus is somewhat indurated, it is better to insert a small, flexible **curette** and scrape the wall of the fistula along its entire length; or **Mathew's fistulotome** may be used. The sinus is now prepared for some one of the various stimulating substances which have been recommended for this purpose. Among these may be mentioned **tincture of iodine**, or, what is still better, a solution of **iodine in ether**, being more volatile, escapes more rapidly, leaving the parietes of the fistulous track in contact with the pure iodine; **silver nitrate**, 240 to 960 grains (8 to 32 Gm.) to the fluidounce (30 c.c.); **copper sulphate**, a saturated solution, or **carbolic acid** mixed with equal parts of glycerin and water. These substances may be applied by means of cotton attached to a silver probe or to an applicator, or, preferably, they may be injected into the sinus by means of a syringe and silver cannula.

If the fistula be a complete one and the substance used be applied as an injection, the finger, covered with a rubber cot, should be passed into the rectum and made to block the internal orifice of the sinus, so as to prevent the escape of any of the fluid into the bowel. A firm pad placed over the anus and supported by a T-

bandage is useful in limiting the motions of the parts, due to the alternate contraction and relaxation of the levator-ani muscle. The chance of success in the palliative treatment of this disease will be greatly increased if due attention be paid to the general health of the patient; when circumstances render it possible, a change of air should be advised. The employment of any of these stimulating substances is always followed by an increase of the discharge for several days, and often occasions more or less discomfort. The intervals between treatments vary from three days to a week or ten days. Personally, I have not found these methods very successful.

Operative Treatment.—The surgeon should examine the patient carefully, not only locally, but also as to the state of his general health, for fistula in ano is not infrequently complicated with other lesions which may render operative procedures inadvisable. Thus, when a fistula is associated with a stricture of the rectum of a malignant nature any operative interference on the former lesion will be out of the question. If it be a simple stricture and its existence be not recognized, or if it be not treated, any operation performed on the fistula will usually fail to effect a cure.

INCISION.—In a number of instances the operation which is sanctioned by experience as the most prompt, certain, and safest, in its results, is to lay open the sinus in the rectum, dividing with the knife all the tissues intervening between its cavity and that of the bowel. The bowels should be moved the day preceding the operation, by means of **blue mass**, 10 grains (0.65 Gm.) at

bedtime, followed the next morning by a **saline**, such as **citrate of magnesia**, **Epsom salts**, etc.

After etherization, the patient should be placed on the back,—in the so-called lithotomy position, the buttocks being brought to the edge of the table. The first step in the operation is to dilate the sphincter muscle slowly, but steadily, by introducing the thumbs into the rectum, back to back, and making gradual pressure around the anal orifice until the muscular contraction is overcome. In male patients, the scrotal holder of Dr. Dwight H. Murray is a most useful instrument.

In dealing with complete fistulæ a flexible probe-pointed director is passed through the sinus, and is then brought out of the anus by means of the forefinger of the left hand introduced into the bowel. The tissues lying upon the director are then to be divided with a sharp bistoury. A careful search is now to be made for any diverticula, which, if found, should be divided. If none exists, the granulations lining the track should be scraped or cut away. The healing process will be greatly facilitated by removing with scissors all overtopping edges of skin and mucous membrane.

A frequent error in operating on fistulous cases consists in not keeping to the sinus, the director being pushed through the track-wall, and then being free to roam about in the cellular tissue of the part, at the operator's will. In this manner, a portion of the fistulous channel is left, and an unnecessary amount of the tissues is divided. Such a mistake can always be avoided by taking plenty of time in performing the operation and by

careful sponging of the sinus as it is laid open, in order to follow granulation-tissue lining the sinus, which by this simple means is freely exposed to view.

The method of treating external rectal fistulæ must vary according to the direction and extent of the track. If the mucous membrane alone intervenes between the finger introduced into the bowel and a probe passed along the sinus, the channel should be transformed into a complete fistula by perforating the mucous membrane with the probe or with a director, at the uppermost limits of the fistulous channel. The regular operation for complete fistula is then to be performed by dividing the intervening septum between the fistula and the bowel. In cases in which the sinus is directed away from the rectum, the proper course is to avoid division of the sphincters when possible.

The treatment of incomplete internal rectal fistula invariably demands operative interference at the earliest possible moment after a diagnosis is made, for if left alone its tendency is to burrow and occasion serious trouble. The operation for this variety of fistula consists in making it a complete fistula and in dividing the intervening structures between the bowel and the sinus. This is best performed by introducing a probe-pointed director, bent at an acute angle, into the bowel, and passing the bent portion through the internal opening. This done, the point of the probe can be felt subcutaneously and cut down upon and the remainder of the operation completed.

In dealing with complex fistulæ the surgeon must be guided by the pecu-

liarities of each case. In operating upon a horseshoe fistula it is important to recognize the true condition of affairs; for a careless or inexperienced observer might think that he had two separate fistulæ to deal with and operate accordingly.

Immediate Suture.—In otherwise healthy subjects, a method of operating which has not met with the success which was hoped for consists in the immediate suture of the wound after the fistula has been excised. The steps of the operation are as follows: The septum between the fistula and the bowel is divided; the entire fistulous channel and all lateral sinuses are excised; buried sutures of catgut, silkworm gut, or of silk are then inserted beneath the wound and around its circumference, at intervals of a quarter of an inch, and tied so as to bring the deep tissues together. The sutures are inserted very much in the same manner as in the ordinary operation for ruptured perineum. The advantage claimed for this plan is that primary union may be secured and the patient recovers in a shorter time than would have been the case after one of the operations which aims to secure union by granulations. The track so frequently becomes infected, however, probably from its proximity to the bowel and its consequent liability to infection from the entrance of fecal matter, and this complication has occurred so often in my experience, that I would advise extreme caution when this procedure is employed, for if the presence of pus is not promptly recognized, the state of the patient is worse than prior to operation. I have practically discarded the employment of this method for the reason mentioned.

Ligature.—This procedure is usually classed among the conservative or non-operative methods on the ground that the cutting is accomplished without recourse to the knife. Silk, linen, and elastic threads have all been used, but at present only the rubber ligature is employed.

The advocates of the elastic ligature maintain that it does not give rise to hemorrhage. This is a matter of considerable importance when the fistula penetrates deeply, and also in those rare cases of hemorrhagic diathesis, in which severe bleeding is apt to follow a trivial incision. The elastic ligature, for which we are indebted to Lee and Holthouse; later to Dittel, of Vienna, and in more recent times to Bodenhamer and the Allinghams, causes strangulation by the firm pressure it constantly exerts upon the included structures; it cuts its way out in a week's time or less. It is stated by those who have had an extended experience with this plan of treatment, that, contrary to what might be expected, the pain attending the ulceration of the band through the tissues is slight, especially after the first twelve hours. Consequently, this method would prove an excellent way of treating fistula if it were to be relied upon to effect a cure. Unfortunately, this is not the case, for it often happens that after the ligature has cut its way through, and the superficial parts have healed, the fistula remains uncured. The reason for this is to be found in the fact that the ligature has dealt with the main track only of a fistula in which exist one or more secondary channels or diverticula. It is, therefore, a measure to be resorted to only when there is an insuperable dread of any cutting

operation; when the fistula is uncomplicated with branch sinuses; in cases of deep fistula in which there is danger of wounding large vessels; in cases in which the patients are debilitated by some chronic disease; and, finally, in patients of known hemorrhagic tendency. It is a valuable adjunct to the use of the knife in dealing with cases in which a sinus runs for some distance along the bowel toward the superior pelvirectal space, but it is by no means a painless procedure, as some would have us believe.

The method of employing the ligature is as follows: A solid india-rubber cord, about one-tenth of an inch in diameter, is threaded to a probe having at one end a rounded opening or eye through which the ligature is passed. The probe enters the fistula from the external to the internal opening, and passes out through the anus. To facilitate the passage of the rubber it should be put on the stretch. After the ligature is passed, a ring of soft lead is slipped over the two ends of the cord; the cord is then tightly stretched and the ring slipped up as high as possible and clamped. If the internal opening be any distance up the bowel, the instrument devised by the Allinghams facilitates the passage of the ligature. It is intended to draw the cord from the bowel out of the external orifice, and not *vice versâ*. Frequently by the time the cord separates the wound has become quite superficial.

This procedure is rarely employed by proctologists, and then only in those cases, previously attended to, in which the sinus runs for some distance along the bowel upward into the pelvis.

J. Rawson Pennington, of Chicago (American Journal of Surgery, Oct., 1907), details his method of operating, so as to avoid, or minimize, the possibility of incontinence following operations upon fistula, which preserves the normal contour of the anus and the functions of the sphincter muscles. His method is as follows: The patient having been prepared in the usual manner, all of the fistulous tracks are injected (when deemed necessary) with some coloring solution, as methylene blue, to aid in searching out their course. Then all of the tracks external to the sphincter, except the one entering the rectum, are divided. A probe-pointed director is passed into the rectum through this track and an incision made on its distal (toward the skin) side. This cut should be made so as to include most of the fibers of the external sphincter, and to locate the transferred internal opening at or near the anal margin. Salmon's "back cut" should then be made on the proximal side of the track, especially if the fistula is of long standing, and the track is fibrous. Then a seton is passed through the opening entering the bowel and tied loosely around the tissues remaining undivided. The wound is dressed as after the ordinary incision operation for fistula. At the end of twenty-four or thirty-six hours it is redressed, care being taken that the opening entering the bowel is made to heal from the proximal toward the distal side. The object is to advance the fistulous track as far distally, or, toward the skin side, as the case will permit, so that it will pass through the fibers of the external sphincters, when the healing process is complete.

As a rule, the enlarged track entering the bowel, except that through which the seton passes, will soon close. When this occurs the seton may be removed; and, by the time the external wound is healed, the track entering the bowel will possibly have closed also. Should it not, at any later time, this little track, which will usually not be more than one inch in length, may be dissected out, and the remaining fibers of the muscle sewed together.

Should the seton be left *in situ* until the wound is completely healed, a small, non-secreting fistula will be seen entering the anal canal, which may be dissected out and sewed together at will. Sometimes this opening will give rise to no annoyance and finally close without further interference.

Should the remaining tissues in this case simply be divided, without dissecting out the track, mutilation of the contour of the anus and loss of control to a certain extent might follow. In such a case the entire track should be dissected out and the ends of the muscle united. This may be done either under local or general anesthesia. It is best performed, however, under the latter.

The question might arise: What is the use of the seton? Would it not be just as well, or even better, not to use it? Pennington thinks not. By using it, the opening into the bowel is transformed and transferred to a point near the skin and the incision, through its use, made to heal from the proximal toward the distal side; or, in other words, with it you can direct and greatly control the healing process and location of the final fistulous track.

The anus not being divided aids the healing of the external wound and prevents much of the contraction and atrophy usually observed after these operations.

By employing this method we simply have an external wound with which to contend. The anus is not mutilated nor disturbed to any great extent, and in some cases not at all, and the patient is usually up and around in a few days. Moreover, the action of the bowels is less liable to infect the wound.

After-treatment.—After the operation of incision, the wound should be packed with **iodoform gauze** and left undisturbed for twenty-four hours, to prevent subsequent hemorrhage. A pad of gauze, over which **carbolyzed oil** is spread, and cotton and a **T-bandage** are next applied. The subsequent dressing of the case should be daily attended to by the surgeon himself. The parts should be kept perfectly clean, and the wound syringed with a 2 per cent. solution of **creolin**, a teaspoonful to a pint (500 c.c.) of water. After this a single piece of **iodoform** (or plain) **gauze** laid between the cut surfaces of the wound will be all the dressing required. The healing process may be greatly retarded by excessive packing of the wound with lint, or delayed by the undue use of the probe. Such interference is to be avoided. If the granulations be sluggish and the discharge be thin and serous, it will be well to apply some stimulating dressing such as the simple **resin cerate** with 20 grains (13 Gm.) of **iodoform** to the ounce, or a weak solution of **copper sulphate** (2 grains—0.13 Gm.—to the ounce—30 c.c.), etc.

The surgeon should be on the watch during the healing process to avoid any burrowing or the formation of fresh sinuses. Should the discharge from the surface of the wound suddenly become excessive it is evident that a sinus has formed, and a careful search should be made for it. Sometimes it begins under the edges of the wound, at other times at the upper or lower ends of the cut surface, and occasionally it seems to branch off from the base of the main fistula. Pain in or near the seat of the healing fistula is another symptom of burrowing; when complained of, the surgeon should carefully investigate its cause.

After an operation for fistula the patient's bowel *should not be confined by the use of an opiate*. The natural dread on the part of the patient, of experiencing pain, the result of a movement of the bowels, will be sufficient to inhibit any action, and the usual experience of the rectal surgeon is that a laxative will be required. The bowels should be moved on the third day by ordering 10 grains (0.65 Gm.) of **blue mass** in the evening, followed by a **saline** the next morning. So soon as the patient feels a desire to go to stool an enema of linseed oil (6 to 8 ounces) should be given, which will tend to render the feces soft and fluid and hence render their passage easier. The patient should be kept in a **recumbent posture** until the fistula is healed; a **moderate diet** may be allowed these patients, as experience has proven that a too restricted one is not as beneficial as was formerly thought. In other words, a liquid dietary is not essential. The time required for a patient to recover after an operation for fis-

tula in ano varies with the extent of the disease. In an average case it will not be necessary to keep the patients in bed over three or four days, and as soon as possible they should be permitted to go out in the fresh air. Some cases may be operated on in the office under local anesthesia; such cases may get well without being confined to the house.

Much hemorrhage rarely follows an operation for fistula, but in some cases it may be necessary to ligate a large vessel. If there should be a profuse general oozing, the sinus may be packed with **iodoform gauze**, or, if necessary, the rectum may be plugged; for this purpose the Allinghams tie a string into the center of a large, bell-shaped sponge, which is passed into the bowel so as to prevent the blood from escaping upward into the colon. They then firmly pack the parts below with cotton dusted with **powdered alum** or **per-sulphate of iron**. In order to allow the escape of flatus, a catheter may be passed through the center of the sponge. As a rule, all hemorrhages following rectal operations are easily controlled by mild measures, such as the **local application of hot water**, of **ice**, or of some astringent, such as a solution of **adrenalin**, 1:1000.

Incontinence of feces is happily of rare occurrence, and follows only extensive operations, especially those in which the sphincter has been divided more than once. When it exists to any extent, it is productive of great annoyance to the patient, possibly more so than the original fistula. The application of the small point of the **Paquelin thermocautery** to the cicatrix of the operation wound will often suffice to relieve this trouble,

by causing contraction of the anal outlet and giving tone and increased power to the sphincter muscle. The Allinghams recommend for this condition freeing the ends of the muscle by a **deep incision through the old cicatrix** and allowing the wound once more to heal from the bottom by granulation. Kelsey advocates **complete excision of the cicatrix**, exposing freely the divided ends of the sphincter and bringing them together by deep sutures, exactly as in cases of a lacerated perineum.

PRURITUS ANI.

SYMPTOMS.—This subject is one of contention, the difficulty arising from the recognized authorities viewing the matter from two different standpoints: On one side we have men like A. B. Cooke, of Los Angeles, Cal., and Louis J. Hirschman, of Detroit, Mich., who assert that it is merely a symptom of some other malady and not itself a distinct lesion. Others equally eminent, such as Jos. M. Mathews, of Louisville, Ky., and Goodsall and Miles, of London, Eng., recognize it as a separate and distinct disease. Without entering into the merits of these divergent opinions, it will suffice for the purposes of this article to state that when a pruritus ani arises and requires a patient to consult a physician for its relief, all proctologists are in accord that nothing short of actual treatment of the itching will effect a cure, even though every other lesion thought to produce it be removed. For this reason, we have deemed the subject one worthy of consideration in a special article.

Pruritus ani may be classed among the most annoying of the minor affec-

tions. Though not painful nor dangerous to life, it may produce marked ill-health by interfering with rest. The severity of the disorder varies considerably, ranging from irritation to intolerable itching. Usually the pruritus occurs at night after the patient retires, and lasts hours.

The itching may be so intense that it is almost impossible to avoid scratching, which, instead of giving relief, adds to the trouble. Nervous and excitable persons are prone to attacks of pruritus during the day as well as at night, especially after exercise, or on leaving the cold air and coming into a warm room. In marked cases, a characteristic condition is the loss of the natural pigment of the part. The skin is not supple, but has a peculiar harsh and rough feel similar to that of parchment paper. It is frequently fissured from scratching.

Impairment of the general health often occurs in these cases, due frequently to broken sleep at night and to annoyances during the daytime. Neurasthenia, melancholia and insanity have been known to occur, and suicide has not only been attempted but effected.

ETIOLOGY.—The causes are both local and constitutional. In many cases it is impossible to discover any causative factor, and it may then be considered, as stated by the Allinghams, as a pure neurosis, occasioned or greatly aggravated by mental worry or overwork. Leucorrheal discharge often excites pruritus by remaining in contact with the skin of the perineum and developing an eczema. In children, especially, it may result from the presence of *Oxyuris vermicularis* in the rectum.

Pediculi, or scabies, may also occasion it, or it may be excited by improper diet and highly seasoned food.

Dwight H. Murray, of Syracuse, N. Y., believes that the cause of all anal itching is to be found in an infection from the *Streptococcus fecalis*. Extensive studies to support this view have been undertaken by Murray, which cover a period of over three years, to which reference will be made under the head of Treatment.

Jerome M. Lynch, of New York City, in a large series of cases, has found the presence of the *Bacillus coli* more frequently than the *Streptococcus fecalis*, and in three instances the *Staphylococcus* was isolated.

Hemorrhoids, polypoid growths, fissure, or fistula, from the irritation they set up and the abnormal secretion they produce, and chronic diarrhea or dysentery may occasion pruritus.

P. Lockhart Mummery, of London, Eng., speaking of leakage of moisture from the anus as a frequent cause of pruritus, calls attention to the fact that catarrhal proctitis is one of the commonest factors in the production of this moisture, and that it is a cause which is frequently overlooked, either because the surgeon is not acquainted with the proper methods of examining the rectum, or, owing to his not having the necessary instruments at his disposal essential for the investigation. This same authority asserts that the usual form of proctitis met with in these cases is the hypertrophic catarrhal variety, characterized by hypertrophy and edema of the mucous membrane, accompanied by an excessive secretion of acid mucus. He also states that there is another form of proctitis, in which the mucous

membrane appears congested and granular on the surface, that both of these varieties of proctitis are chronic and are usually unsuspected until an instrumental examination of the rectum is made. In both of them there is present an excessive secretion of acid mucus, the constant presence of which irritant material, in contact with the sensitive mucous membrane of the anal canal, he believes causes the pruritus.

Erythema, herpes, and any variety of eczema, whether acute or chronic, may also give rise to it. It has also been traced to stricture and inflammation of the upper portion of the urethra. It frequently depends upon a varicose condition of the hemorrhoidal veins, just as occurs in a similar condition of the veins of the lower extremity. Uterine disorder, uncleanliness, and insufficient ablution of the anus, and, finally, the use of hard or printed toilet paper may excite it.

A. B. Cooke, of Los Angeles, Cal., thinks that, of all the constitutional causes, intestinal flatulence, with its accompanying constipation and catarrhal inflammation, is by far the most frequent. He states that this fact is deserving of special emphasis, for he has so often noted this condition in cases of pruritus ani, and so often have his efforts to relieve the latter resulted in failures and disappointment until the former received attention, that when the existence of this intestinal disorder is determined he regards its proper management the most important indication of the treatment of the case.

Gouty subjects and persons with a more or less marked lithic acid

diathesis are predisposed to attacks of pruritus ani. Hepatic disorders, which may or may not be associated with constipation, diabetes, and chronic constipation, frequently act as causes, while excessive smoking and the free indulgence in alcoholic liquids or of coffee may also induce it. Excesses at the table, combined with a lack of proper exercise, not only predispose to pruritus, but also may become its exciting cause. It has also been ascribed to disease of the spinal cord and brain.

Fred. C. Wallis, of London, Eng., believes that in over 90 per cent. of his cases the cause of the malady under consideration is the presence of a shallow ulcer, usually found between the two sphincters, more often in the posterior half than in the anterior anal canal, and generally near the dorsal midline. In some instances Wallis states that more than one ulcer exists and that in other cases there are found various clefts, which occasionally almost surround the bowel. The ulcer is not easily recognized by the touch and a certain amount of practice is required to appreciate its presence. When a specular examination is attempted the ulcer will appear as though higher in the bowel than it really is, by reason of the instrument used pushing the tissues in. Under these circumstances the ulcer can be clearly seen and appears as a shallow, oval, livid abrasion, differing markedly in color from the normal mucous membrane.

TREATMENT.—In the majority of instances, especially if there be no ascertainable local factor present, the affection must be treated by constitutional remedies as well as by local means. The Allinghams state that

the difficulty experienced in its treatment has arisen in a great measure from its having been considered as merely a local affection, and only local means having been applied for its relief.

If the patient shows a lithemic tendency he must be treated accordingly. **Out-of-door exercise** should be advised; the **diet** should be carefully **regulated**; meats should be taken in small quantities. Rich gravies, sauces, and pastry are to be avoided, as well as most sweets; malt liquors and all wines except claret are objectionable.

Turkish baths are beneficial when taken once or twice a week. General **massage** is also of advantage. Medicinally, the **lithium salts** are indicated, either in the form of **natural mineral waters** or the **effervescing lithium-citrate tablet**. In cases in which the irritation is very severe, the **wine of colchicum**, in doses of 5 to 20 minims (0.3 to 1.25 c.c.), every four to six hours, answers best. Cripps recommends the following formula of Brodie's:—

℞ *Magnesia* gr. vj (0.4 Gm.).
Potassium bicarbonate gr. xv (1 Gm.).
Potassium tartrate. gr. x (0.65 Gm.).

M. Sig.: To be taken with water twice daily, three hours after meals. The second dose may be taken with advantage on going to bed.

This must be persevered in for at least ten days in order to properly test its efficiency.

The Allinghams found that when gout, active or latent, was the cause of pruritus ani, the irritation was best allayed by the local use of a strong **solution of sodium bicarbonate** or of **sodium disulphite** (1 dram—4 Gm.—

to the fluidounce—30 c.c.—of water) frequently applied in a poultice.

In functional derangement of the liver, if dependent upon a gouty diathesis, the **diet** should be carefully regulated. The use of alcohol should be restricted. Considerable benefit is to be derived from the use of aperient medicines, of which the salines are the best, as **sodium phosphate**, or the **sulphate**, or the **natural mineral waters**. In some cases marked improvement results from the use of **mercury** in some form, such as the fractional dose of **calomel** or **blue mass** in 5- or 10- grain (0.3 to 0.6 Gm.) doses. **Ammonium chloride** in 10- to 15- grain (0.6 to 1 Gm.) doses, four times daily, is a useful remedy in hepatic congestion. **Nitrohydrochloric acid** in combination with **nuxvomica** and **compound tincture of gentian** or of **cardamom** often proves of value.

When chronic constipation is present the first step in correcting this condition is to instruct the patient to go at a certain hour every day to the closet, whether the desire exists or not. In most instances a morning hour will prove best, either before or after breakfast. **Physical exercise** is another important factor.

Certain articles of food to assist in the correction of constipation are often of value, such as the **fruits**, of which apples, prunes, and oranges are the best.

No one plan can be outlined that will benefit all, or even the majority of persons afflicted with constipation. The individual indications are the only means by which we can successfully gauge the remedies required. Some authorities are strongly opposed to the continual use of laxatives

in cases of obstinate constipation, but without their employment some patients would never have a bowel movement. Many inordinately use cathartics and laxatives, but this fact offers no valid objection to their employment by the physician when the patient is unwilling or unable to stand the expense and time necessary to be cured of constipation by other means. Sometimes a tumblerful of **hot or cold water** taken **before breakfast** will regulate the bowels. The hot water can be made most palatable by adding to it a pinch of salt. If this should fail, the **mineral waters** may be tried, especially the **Hunyadi Janos**, a wineglassful of which, followed by a half-tumblerful of hot water, may be taken. Fluidextract of **cascara sagrada**, with equal parts of **glycerin**, in doses of 30 to 60 drops at bedtime, will often prove useful. **Phenolphthalein** in capsules of 2 to 4 grains (0.13 to 0.26 Gm.) taken at bedtime is serviceable. (See also CONSTIPATION, volume ii.)

In intractable cases of pruritus ani, the urine should be examined for sugar.

The Allinghams state that when pruritus is of neurotic origin, as they think it frequently is, particularly in spare and delicate, excitable people, **arsenic** and **quinine** should be freely given, separately or combined. They should be pushed to their physiological effects. The internal use of opium in any form is contraindicated. Most authorities agree that though a night's rest may be procured by its employment, its use aggravates the disorder. This fact cannot be too strongly emphasized.

Local Treatment.—The pruritus induced by uterine catarrh can only

be permanently removed by the cure of the prime factor in its causation. Relief from the itching can be afforded by **cleanliness**, frequent washing of the parts, and by the use of **vaginal douches**. Various sedative applications may be tried, such as 1 part of the officinal solution of **plumbic subacetate** to 4 parts of water, applied three or four times daily by means of cotton pledgets; or a lotion composed of 1 ounce (30 Gm.) each of **chloroform**, tincture of **aconite**, and tincture of **opium** and 6 ounces (180 c.c.) of **olive oil** or **linseed oil**, which is to be shaken well before using and is to be smeared over the parts whenever the pruritus becomes annoying.

The elimination of *Oxyuris vermicularis* and the relief of any cutaneous inflammation about the anus which their presence has occasioned will materially assist the cure of the pruritus. To destroy the worms it is not sufficient to rely entirely on rectal medication, such as **enemas of lime-water**, weak solutions of **quinine** (20 grains—1.3 Gm.—to the pint—500 c.c.—of water), or of **corrosive-sublimate** solutions (1 part to 4000), for these only accomplish the destruction of the parasites in the rectum. In addition, it is essential for their complete eradication to add internal medication, so as to reach the seat of their propagation in the small intestine. (See PARASITES, INTESTINAL.)

When pruritus is caused by animal or vegetable parasites, it is readily cured by the application of the **sulphur ointment**, gently rubbed over the affected area at bedtime. The ointment should contain from $\frac{1}{2}$ to 1 dram (2 to 4 Gm.) of sulphur to the

ounce of benzoated lard, and it should be employed every night for a week or ten days. The use of strong sulphur ointment for any great length of time is injudicious, as the cutaneous surface of the parts is apt to become irritated. A cleaner and an equally efficient remedy advised by the Allinghams is a lotion of **sulphurous acid**, of the strength of 1 part to 6 of water. Samuel T. Earle, of Baltimore, Md., recommends strongly the use of a 2 per cent. **ointment of salicylic acid** or one of 3 per cent. of Calvert's **carbolic acid** for the destruction of the fungus which produces the eczema invaginations, a not infrequent cause of pruritus ani, as microscopic examination will always make the diagnosis clear.

The removal of hemorrhoids, polypoid growths, fistula, and fissure will enable remedies applied for the relief of a pruritus to effect a cure, when otherwise the disease will prove intractable. J. M. Mathews ("Diseases of the Rectum," 1892, pp. 494-97) alludes to a fact which is worthy of emphasis, viz., that when pruritus is established, the treatment of any organ or local condition which caused the affection will not necessarily cure the pruritus.

The pruritus associated with varicose veins of the rectum may be relieved by measures calculated to tone up the part and to lessen any tendency to congestion. **Bathing the anus night and morning and after a movement of the bowels** will often accomplish this purpose. To prove efficacious a sponge must be soaked in cold or hot water and squeezed dry by pressing it against the anus. This procedure must be repeated about a dozen and a half or more times



Gonorrheal Abscess of Colon Caused by Infection of
Vaginal Origin.

at each bathing. Another excellent treatment is to use an injection into the bowel daily of about 2 drams (8 Gm.) of the following formula:—

℞ *Fluidextract of hamamelis* f℥j (30 c.c.).
Fluidextract of ergot. f℥ij (8 c.c.).
Fluidextract of hydrastis f℥ij (8 c.c.).
Compound tincture of benzoin f℥ij (8 c.c.).
Carbolized olive oil or linseed oil (oil, 5 per cent. carbolic acid) f℥j 30 c.c.).

M. Shake well before using.

Sig.: 1 to 2 drams (8 c.c.) as an injection.

Pruritus Ani per se.—All discoverable local or constitutional causes of this disease having been excluded, we are brought to the consideration of a class of cases, by no means small in number, to which the term “neurotic” has been applied. That the condition is due to a neurosis, reflex or otherwise, is a little difficult to confirm, but it is a plausible explanation, and is a theory warmly advocated by Mathews. These cases often tax the physician’s resources to their limit. What relieves one patient will utterly fail in another, and what gives relief for a time may lose its effect entirely. Furthermore, it is impossible to state, with any degree of precision, as to the form in which remedies should be used, for, as stated by the Allinghams, “in cases which appear best suited to ointments, the ointments may utterly fail, and a powder which you feared would be utterly useless may effect a cure.” Therefore they advise their readers “to ring the changes between ointments, lotions, powders, and caustics.”

Hot water applied as hot as can be borne to the **region of the anus**, while

it may temporarily increase the itching, acts as a temporary relief when employed at bedtime, **provided the parts be not rubbed**. It also paves the way for the application of other remedies by making the parts more susceptible to their action.

Among the curative remedies recommended may be mentioned **black wash**, **nitrate of mercury ointment**, **nitrate of silver** in solution, **chloroform**, **compound tincture of green soap**, **carbolic acid**, **calomel ointment**, **balsam of Peru**, **tincture of aconite** and of **belladonna** (equal parts), **camphor** and **carbolic acid** (equal parts), **menthol**, and the **hyposulphite of sodium**.

Goodsall and Miles, of London, Eng., have successfully treated two of these cases with pure **formalin**. They state that the application causes much pain and advise that the patient should be under the influence of an anesthetic when the drug is used. After the formalin has been applied they recommend the use of a strong solution of **cocaine** to the affected area. After an interval of four hours, **boric acid** fomentations should be commenced and should be continued until the parts are healed.

A plan of treatment which in my practice has proved most efficacious, is as follows: When the parts are found to be excoriated from scratching, etc., they are painted over with the compound tincture of **benzoin**,—which the patient is forewarned will cause momentary smarting, due to the alcohol in the preparation. If the skin has a harsh and dry appearance, the entire surface around the anus for several inches outward is painted with a strong solution of **silver nitrate** (often a saturated solu-

tion). In my experience, the use of a strong silver solution is not nearly so painful, though temporarily it smarts more, as the weaker solutions. The application of the silver may have to be repeated two or three times before the desired effect is obtained, not oftener, however, than every third day. By its use the skin becomes supple and healthy-looking. So soon as the parts permit, usually on the second or third visit, and thereafter, I spread over the anus and the cutaneous surface thereabouts, for a distance of about two inches, the officinal **citrate ointment** (*unguentum hydrargyri nitratis*). *The ointment is always used in its full strength.* Over the salve I place a wad of absorbent cotton, varying in size with the patient's comfort and convenience. The dressing is kept in place with a T-bandage. The patient comes to the office for treatment in the morning, and is advised to wear the dressing all day and night. If the itching should prove annoying during the night, direction is given to bathe the parts with hot water, as hot as can be borne with comfort, *but under no circumstances to rub or scratch the parts.* He is also told that the **application of the hot water** will momentarily increase the itching, but that he is not to scratch. After he has used the water, he is directed to use either a solution of **black wash** (*lotio nigra*), or, what is better in some cases, **calomel ointment** (10 per cent. calomel, with benzoate of lard as a base), either of which is to be applied locally to the affected parts.

Prior to coming to the office for the next treatment, he may wash the parts with Castile soap and hot water, but this is not essential as a routine

practice. In bathing the parts no rubbing is to be permitted.

For the first two or three weeks the patient is seen every day; then every other day, for a like period or longer time, frequently for six weeks, after which time once or twice a week will suffice until such time as I am satisfied that the disease is conquered. Usually this treatment consumes, in its entirety, not over six months. In no case should a definite promise be made to a patient as to the length of time the treatment will consume. Such a course, as a rule, leads to disappointment and dissatisfaction. It is perfectly proper to cite the experiences had with other patients with like affection, as examples of what may reasonably be expected by the patient about undergoing treatment.

I am also in the habit of warning patients that, at any time during the course of treatment, the itching may return suddenly and be as severe as at any time prior to coming under my observation, but that this must not be deemed a bad omen, as such occurrences are often experienced, but that they have no special significance.

Sometimes during the use of the nitrate of mercury ointment, the anus and adjacent parts become sore. Under these circumstances the ointment will have to be discontinued for a few days; during the interim, I employ the calomel ointment, in the same manner as directed for the use of the other mercurial salve. I have never witnessed any bad effects from the use of mercury, such as salivation, etc.

To conclude, I will simply add that I have treated quite a large number of patients by this method, and that

I have yet to experience a single failure to effect what thus far has seemed a radical cure. Some of the patients have been treated as long as twenty years, but in no instance, so far as I have had knowledge, has there been any marked return of the trouble. In some few of the cases a patient has returned a year after his discharge, for three or four treatments, owing to some slight sensations experienced about the parts, which they were afraid might portend a return of the old trouble, and wisely deeming that a stitch in time saves nine, sought advice before the much-dreaded affection had an opportunity to obtain another foothold.

Dr. Dwight H. Murray (Transactions American Proctologic Society, 1912) having made a bacteriological examination in a number of cases of pruritus ani, has come to the conclusion that a streptococcal infection of the perianal skin is the etiological factor in a large number of cases. He believes that the excessive moisture and the infiltrated condition of the skin are due to a low form of inflammation caused by streptococcal skin infection. Out of 32 cases of pruritus ani in which no definite cause of the irritation could be found, and which were examined bacteriologically, he discovered streptococcal skin infection present in all, while in a series of control cases, in which no pruritus was present, he found no streptococcal infection of the anal skin. He claims good results for treatment with **autogenous vaccines**, but states that the ordinary stock vaccines are not to be depended upon, and that a special vaccine should be prepared for each case. In a series of very carefully recorded cases, marked

improvement was shown in all treated in this way. If the streptococcal infection was alone the cause of the trouble, one would reasonably expect that the number of real cures would have been greater. Dr. Murray's investigation is, however, a valuable one and his methods well worth trying in suitable cases. The following is the technique he advises for the treatment by this method:—

The perianal skin is first thoroughly cleansed with liquid soap and water, then with sterile water. The parts are then lightly dried, after which a swab is rubbed over the skin, particularly in any place where fissures exist. It is occasionally advisable to scrape the skin slightly with a curette, especially if bacteria fail to be obtained in the ordinary way. These swabs are then sent to the bacteriologist, who places them on endomedium. The growth is examined after twelve hours, and usually a pure culture of streptococci (generally *Streptococcus fecalis*) is discovered.

The differentiation between streptococci and other germs can be made by growing them in liquid media; streptococci are then found in chains of three or four. For a more acute differentiation, to ascertain to which branch of the streptococcus family the particular organisms belong, Dr. Murray advises they should be grown on Gordon's series of carbohydrates. A concentrated vaccine is made by transferring a colony from the Petri plate and allowing it to grow on slant agar for twenty-four hours, washing it off with an average 1 c.c. sterile salt solution, and then draining into a small bottle through cheese-cloth. An equal volume of 1 per cent. car-

bolic solution is then added, and the resulting solution allowed to stand at room temperature for twenty-four hours before using. Dr. Murray advises that this vaccine should be injected subcutaneously, beginning with 2 to 4 minims (0.12 to 0.24 c.c.) to test the susceptibility of the patient. If no reaction occurs within twenty-four hours, a double dose should be given the next day. After a reaction has been obtained, the injection should be repeated as soon as the last reaction has disappeared,—injections being given into different parts. Dr. Murray particularly insists upon the importance of repeating the treatment directly there is recurrence of the pruritus.

J. P. Lockhart Mummery, of London, England, has tried this treatment in several cases with a certain amount of success. It seemed to him, however, that if the streptococcal infection of the skin, which is undoubtedly present on testing in many of these cases of chronic pruritus, is the cause of the itching, the best method of getting rid of the infection is direct local application rather than the use of an autogenous vaccine. He states that we are not in the habit of using autogenous vaccines to sterilize a patient's skin before operating, as we have other and more effectual methods. Acting on Dr. Murray's theory that a streptococcal infection is sometimes the cause of pruritus, he has recently tried the following method:—

A patient's skin is tested for the *S. fecalis* by Dr. Murray's method, and if this is found the patient is treated by painting the anal skin with a 2 per cent. solution of iodine in 75 per cent. rectified spirit, and this so-

lution is then driven into the tissues by **cataphoresis**, in the same way as ionization is carried out in the rectum (see Mummery's work, "Diseases of the Rectum," 1914. A moderate strength of current applied for fifteen or twenty minutes is generally sufficient to drive the iodine well into the skin; several applications are given at intervals according to the resistance of the patient's skin. If the treatment is given too frequently, the skin will be made sore, and may even become blistered; one must, therefore, go cautiously at first. This method appears to be the most effectual for sterilizing the skin in this neighborhood; it does not cause any pain, nor does it necessitate the patient's confinement. He has not yet used the method in a sufficient number of cases to make any authoritative statement as to its efficacy; so far, however, in the cases in which it has been used, it has given immediate relief, although there has often been a recurrence one or two months afterward, necessitating a repetition of the treatment. The method is certainly one that is well worth trying. It appears to this author to be more effectual than any other local method in use hitherto.

Violet rays and the **X-rays** have each been indorsed for the treatment of this affliction. J. Rawson Pennington, of Chicago, Ills., reported a series of cases successfully treated by the Röntgen rays. (Paper read before the American Proctologic Society, in 1903.) I have personally seen but little benefit from the employment of these measures. In fact, in several instances quite an extensive dermatitis ensued from the use of the X-rays.

Various **surgical procedures** for the relief of pruritus have been devised and employed by many of the leading proctologists, both abroad and in this country. Personally I have never been obliged to resort to these measures, but, in justice to the subject, will describe the same. Since Sir Charles Ball, of Dublin, in his work on "The Rectum" described his method of operating for the cure of pruritus ani, many modifications of his plan have been suggested.

As **Lynch's operation** is the latest one detailed, and as the fundamental basis of all the various procedures have but one object in view, to wit., the complete division of the sensory nerve supplying the affected area, I shall describe his method in full:—

The entire operation is performed under local anesthesia, and in no way inconveniences the patient or enforces confinement. Lynch claims that it is not beset with possible complications as are other procedures; there is a minimum amount of scar formation, and the direction of the scar makes stricture impossible; while the blood-supply of the operated area is so little disturbed that the danger of sloughing is *nil*.

The patient is placed upon his left side, with knees and thighs flexed. A point is chosen about one and a quarter inches from the anus. At this point a 1 per cent. solution of **novocaine** or a one-fifth of 1 per cent. solution of **cocaine** is injected. More recently a 2 per cent. solution of **hemesia** has been employed by preference.

An area extending to the posterior midline is anesthetized. At the point above mentioned a small, curved incision is made, about half an inch

long and extending just through the skin. Through this incision a blunt-pointed dissecting scissors, curved on the flat, is introduced. With this instrument a blunt subcutaneous dissection is now carried out, working to the anus mesially and to the raphés anteriorly and posteriorly. When completed there is an area of skin, extending from the anterior raphé to the posterior commissure and involving all the skin within a radius of one and a half inches from the anus, which has been deprived of its sensory nerves. Any bleeding may be controlled by pressure. When the bleeding has stopped, a small piece of rubber tissue is introduced into the incision and permitted to remain twelve to twenty-four hours. Sometimes, in addition, a horsehair stitch is taken through the incision, but this is not usually necessary. As a rule, at the end of forty-eight hours, the wound is entirely healed. Either at the same sitting or at some subsequent time, the same procedure is followed on the other side.

The results of this operation, Lynch asserts, has always been satisfactory. Though there may be a recurrence, this is not likely to take place for two or three years; and two or three years of relief to a patient is often a great boon. The itching, of course, ceases immediately, and perianal sensation being lost, the irritation soon lessens. With proper treatment all local conditions should promptly clear up.

Lynch employs this operation only after all medicinal means have failed; but believes that it is the most certain means of all to insure relief from this aggravating condition.

PROLAPSE OF THE RECTUM.

The term "prolapsus," or "procidentia recti," signifies a protrusion or eversion through the anus of any part of the rectum, consisting of mucous membrane, either alone or combined with one or more of the coats of the bowel. Occasionally the protruded part contains within its folds a loop of the small intestine.

There are three forms of rectal prolapse: (1) prolapse of the mucous membrane alone [partial prolapse]; (2) prolapse of all the coats of the rectum [procidentia recti]; and (3) prolapse of the upper portion of the rectum into the lower, called invagination, or intussusception, in other parts of the intestinal tract.

PROLAPSE OF THE MUCOUS MEMBRANE.—In this variety the mucous membrane only is extruded, sliding away, as it were, from the muscular coat by the stretching of the loose submucous tissue which connects the two coats. The prolapse, in these cases, is necessarily limited, the protrusion being seldom more than an inch or two in length. This condition may occur at any age, though it usually occurs at the two extremes of life.

SYMPTOMS.—The prolapse may be immediate as a result of vomiting, coughing, etc., or it may come on more gradually. The more the bowel is protruded, the more the parts become stretched and relaxed and favor the repetition of the descent of the rectum. When the attack comes on suddenly, there is apt to be considerable pain, and a tumor-like mass, red in color, projects from the anus. Frequently, blood is seen oozing from its surface. If the prolapse be of one that has often occurred, the mucous

membrane shows evidences of superficial catarrhal ulceration. In some instances the submucous inflammation causes the surface of the protrusion to appear perfectly smooth, but usually the mucous membrane appears as bright-red folds, with sulci between them, which radiate from the anal aperture. At first the protrusion only occurs at stool, and is readily reduced; in some cases it becomes spontaneously reduced. In chronic cases it becomes more difficult to replace, and may occur independent of fecal action. In these cases the mucous membrane is greatly thickened and the submucosa more or less infiltrated; a mucopurulent discharge is common, while bleeding, though slight, often occurs. The protrusion of internal hemorrhoids is frequently associated with prolapse of the mucous membrane; this condition, however, ought always to be readily distinguished from the disease under consideration. Hemorrhoids are more isolated and are much firmer to the touch.

Complete Prolapse, or Procidentia Recti.—When partial prolapse has repeatedly occurred, it is apt to result in the more serious form, in which all of the tunics of the bowel are involved. In some instances an extensive prolapse takes place suddenly as a result of violent straining. In both conditions the tumor forms a protrusion of variable size, more or less pyramidal in form, which projects from the anus. At its distal end is the opening into the bowel, and this opening is generally narrow and slit-like.

When the prolapse involves more than two and a half inches of the rectum, it is well to remember that

the peritoneum may be involved, and that, within this serous sac and included in the prolapsed portion of the rectum, a coil of the small intestine may be found. In this variety there is no invagination. This form of prolapse may assume extensive proportions, the greater portion of the colon being extruded.

The symptoms of complete prolapse are similar to those in the first variety, but are usually more aggravated. Mucus is present, and even pus may be found when this condition is associated with ulceration. Pain, when present, is not usually severe, as the mucous membrane here seems to be purposely endowed with a lowered sensibility. This fact accounts for the considerable amount of trauma which the rectal mucous membrane stands without producing much suffering, as is exhibited in advanced and extensive malignant disease of the rectum. When the peritoneal coat of the intestine is involved, the sac of the hernia, so called, is to be looked for upon the anterior surface of the protrusion, as the peritoneal pouch does not descend nearly so far upon the posterior as upon the anterior wall of the rectum. Where the protrusion measures more than three inches, Ball states that the mass is generally curved, the concavity looking toward the coccyx, and in extreme cases it may be arranged in a more or less spiral manner.

Prolapse of the Upper Portion of the Rectum into the Lower.—This disorder is called “invagination” or “intussusception” in other portions of the intestinal tract. It is described by J. M. Mathews as one “where the finger can be inserted into a groove

alongside of the base of a tumor so that a distinct sulcus is recognized, of more or less depth, at the bottom of which, if not too deep, the lining membrane of the bowel can be felt as it is reflected from the base of the protruding mass.” In such a case the rectum has begun to fold upon itself; in other words, to become invaginated, or “telescoped,” the upper part of the bowel always passing within the lower, at a point more or less distant from the anus, yet generally within the reach of the finger. This subject has been considered in the article on *INTESTINAL OBSTRUCTION*, vol. iv, and is mentioned here only for the sake of emphasizing the importance of recognizing the condition, especially as its treatment from a surgical standpoint differs materially from the operative procedures to be advised for the relief of the other two varieties of prolapse.

DIAGNOSIS.—Though it is a comparatively simple matter to diagnose a prolapse, mistakes are frequently made. In children, polypoid growths are more frequent than the literature would seem to indicate. In the adult, hemorrhoids may be mistaken for prolapse. Mathews suggests, in doubtful cases, that the adult patient be instructed to take an enema and to strain. If it be a prolapse of the mucous membrane, it will occupy most or all of the circumference of the bowel, with a certain degree of regularity. The bowel will be of a bright-red color, and if grasped between the fingers its folds can be easily pressed together, there being no well-formed tissue existing. In protruded hemorrhoids the prolapse is irregular and does not include the circumference of the bowel,

and oftentimes exists only on one side; and if the parts are seized a well-organized tumor can be felt, which can be circumscribed; the color is usually a dark blue. Another point to which Mathews directs attention is the size of the protruding mass. Simple prolapse is never very large, and where any of the coats of the rectum or all of its coats are included, the protrusion is much larger. A simple prolapse of the bowel does not usually remain out for any length of time, and a prolapse containing the coats of the rectum is very apt to remain out an indefinite time, or until reduced.

J. M. Lynch, of New York, mentions a valuable diagnostic factor in recognizing at a glance the difference between an incomplete and a complete prolapse,—in the former, the folds are sulci, are longitudinal and radiate from the center to the circumference, whereas in the latter variety the folds are circular.

ETIOLOGY.—Straining at stool is the most frequent exciting cause. Children are especially predisposed to prolapse, because the rectum is nearly vertical and the mesocolon is of considerable length. The unfortunate habit of placing a child upon a commode and leaving it there for a long time to establish regularity of habit is a rather common cause of prolapse. Stone in the bladder and phimosis, by the straining efforts produced at urination, are factors not to be overlooked in searching for the cause of this disease. It is often due to ascarides, to rectal polypi, and frequently to violent fits of coughing, as in whooping-cough.

In adult life the prolapse may be traced to some cause which leads to

unnecessary straining efforts, such as enlarged prostate.

PROGNOSIS.—When the mucous membrane alone is involved, a spontaneous cure is frequently effected; in children this result is more especially noticed. Mild measures often assist nature. In the aged or in the young, where hypertrophy has occurred to any marked extent, operative measures are usually required to insure recovery. It is well not to promise too much to these patients as to the time necessary to effect a cure, as some cases respond but slowly to treatment.

TREATMENT.—No matter what variety of prolapse we are dealing with, efforts should be made to **return the mass as speedily as possible**. In some cases considerable difficulty may be experienced. Children should be laid across the knees and the entire mass should be subjected to gentle, but steady, pressure for some moments, so as to reduce the bulk of the tumor by the squeezing out of the fluid contents. The central portion should be returned first; this is best accomplished by inserting the finger into the lumen of the bowel; then, by pressure of the fingers of the other hand, its remaining portions may be gradually pushed within the anus. Persistence in **taxis** will in nearly all cases suffice. In difficult cases, the suggestion of A. B. Cooke, of Los Angeles, will often prove of value and consists in the use of a **cone of toilet paper** placed over the well-lubricated index finger, which is **introduced into the aperture and pushed up into the bowel**, carrying the prolapsus with it. After which the finger is withdrawn, leaving the paper cone in place to be evacuated

at the next stool. When all efforts at reduction fail, an anesthetic should be administered, the **sphincter divulsed** and the **protrusion replaced**, or, if circumstances permit, a **radical operation** for the permanent relief of the trouble should be performed.

L. J. Hirschman, of Detroit, has employed and found most satisfactory **compresses, soaked with 1:1000 solution of adrenalin chloride**, applied with firm pressure to a prolapse, especially in cases where it has remained outside long enough to become swollen, edematous, and congested. Its use makes reduction comparatively easy by constringing the blood-vessels and greatly reducing the size of the protruded mass.

In some cases **artificial supports** are needed. A belt may be placed around the waist and an elastic band, having a solid or inflated pad attached, is passed between the thighs in such a manner as to press the pad against the anus. The anterior part of the band is divided so as to come up to the belt in front of each side of the genitals. Another form consists of a belt, half steel and half leather, buckled about the hips just above the trochanters, while a bent steel spring passes down behind and carries a pad to press against the anus. In temporary cases it assists the stability of the pad to draw the nates together with a broad strip of adhesive plaster (Andrews).

S. B. Powell recommends a plan which "consists in rolling in and **strapping the buttocks together with two strips of adhesive plaster**, extending sufficiently forward to secure a good hold. The child (or adult) defecates with these in position, is thoroughly cleansed after the

act, and new strips are applied. This method, which, in the hands of the inventor, has never failed, is based upon the fact that the relaxed sphincter is elevated and supported during the strains put upon it while the child is at play, and is protected from the lateral traction occurring in the squatting position assumed in defecation. It and the parts above gradually regain their contractile power, and ultimately become competent to fulfill their functions normally" (Andrews).

In all cases attention should be paid to **regulating the actions of the bowels**, and, instead of permitting the patient to sit in the usual position, **defecation should only be permitted either in the recumbent posture**, lying upon the back or side, **or while the patient is standing**. It is also of assistance for the patient to become accustomed to having the movement of the bowels occur the last thing before retiring, so that rest may be obtained immediately thereafter.

If possible, the cause of the prolapse should be ascertained. A catarrhal condition of the rectum, a polypus, oxyurides, a phimosis, or a stone in the bladder should always receive the proper treatment before a satisfactory result can be obtained in dealing with the prolapsus.

Astringent applications for the relief of prolapsus are generally useless. **Cold water applied to the anus**, either with a sponge or as a douche, is as serviceable a remedy as any drug. The astringent remedies advised, in this connection, are: **alum, tannin, sulphate or chloride of zinc, chloride of iron**, etc.

Cauterization, either by the actual

cautery or by the employment of the **nitrate-of-silver stick** in cases of partial prolapse, may prove a very satisfactory method. S. G. Gant, of New York, has successfully employed **nitric acid** for the relief of children suffering from this malady. The surrounding parts are first protected by vaselin, and linear cauterizations made by the acid applied by means of a glass rod; the length of the cauterized line and the distance beyond will depend upon the extent of the protrusion. At the completion of this procedure, a piece of gauze or cotton should be inserted into the rectum to keep the walls of the bowel separated and to absorb any excess of acid. **Excision of elliptical strips of the mucous membrane** is sometimes necessary and often suffices for effecting a cure. Hypodermic injections into the coats of the bowel are not to be advised. Vidal, quoted by the Andrewses, has used **ergotine**, in this manner, with asserted success.

Various surgical procedures have been devised for the relief of complete prolapsus; in fact, their number is legion. A consideration of all of these is out of the question, and we shall only attempt to mention several of the methods or types of those whose value experience has proven serviceable:—

Gant's Posterior Proctoplasty.—This operation is advised in cases of severe prolapse, and affects a cure by attacking the bowel from behind and shortening it several inches. The patient is placed in an exaggerated Sims position, and is given a general anesthetic. The parts are aseptized and an incision one and one-half inches in extent is made just below and transverse to the coccyx,

and carried down to the rectum, which is freed from its posterior attachments. The sphincters are then divulsed, and, with the index and middle fingers passed as far as possible into the rectum, the bowel is pushed out through the opening made by the incision and pulled down as far as it can be protruded. A longitudinal incision, from two to four inches long, is now made through the rectal coats, and the bowel is shortened the length of this incision by bringing the angles of the cut together, thus making its direction transverse and closing it with the Lembert sutures of fine silk or catgut. Before inserting the sutures all hemorrhage must be arrested. The wound is then dusted over with aristol and the bowel replaced through the external incision, which is then closed with catgut.

The rectum should now be irrigated and dried and the intrarectal wound protected from infection by non-absorbable wool, dusted over with iodoform. Unless strict asepsis be maintained, the author of the method calls particular attention to the likelihood of its being attended by infection, abscess, and fistula.

Lockhart-Mummery Operation.—The object of this procedure, like that of all other forms of proctoplasty, is to anchor the rectum by adhesion to the sacrum and surrounding pelvic fascia. In the hands of its author, it has proven most satisfactory in dealing with cases of prolapse of the first and second degree, and his experience with this method extends over a period of ten years. Not only is it essential to prepare the patient for operation in the usual antiseptic manner, but it is a matter of con-

siderable importance to insure that no action of the bowels shall take place for at most four or five days after operation; in fact, until steps are taken to effect that end. The patient is placed in the lithotomy position with a small sand-bag under the sacrum. A transverse incision, about two inches long, is made at a point about half-way between the top of the coccyx and the posterior margin of the anus, and the attachment of the external sphincter to the coccyx is completely divided. The incision is carried down toward the tip of the coccyx, a knife or blunt-pointed scissors being used, until the posterior rectal space is opened. On no account should the rectum be opened. Next, a gloved finger is inserted through the incision and the posterior rectal space is opened up by blunt dissection so as to free the bowel laterally, and the extent of this separation upward should, roughly speaking, equal the length of the prolapse when down. This done, a long strip of sterilized bismuth gauze (with a selvedge) should be carefully packed into all the separated areas of the posterior rectal space, the object being to leave sufficient gauze to prevent primary union between the rectal wall and the sacrum, but to avoid using an unnecessary amount as would cause pressure upon the rectum or be likely to produce sloughing. When the prolapse is large and of long duration, the separation should be carried into the space between the levator ani and between this muscle and around the bowel. Two or three strips of gauze should be used and the ends left hanging out of the posterior wound. A portion of the anterior wall of the mucous mem-

brane of the rectum just within the anus should be seized with forceps and tied with a ligature, so as to prevent any tendency to prolapse, as otherwise this portion is liable to prolapse into the patulous anus after the posterior wall has been fixed. If the anus is very patulous, some form of plastic surgery may be necessary, otherwise not. A plug of sterilized gauze soaked in ointment is passed into the anus to prevent any leakage, and the parts are dressed with antiseptic gauze.

After the operation the patient must be kept flat in bed and not allowed to get up for any purpose. A light and easily digested diet should be given until the bowels have been opened. The gauze should be left in place until the sixth or seventh day, and these pads of it should be slowly removed each day, fresh gauze being lightly packed into the space left. The object of the packing is to make the whole of the space opened up behind the rectus heal by granulation, so as to produce the maximum adhesion of the involved area. Subsequently the dressing should be done daily, and it should take the wound not less than three weeks to heal. About the sixth day the bowels should be opened by an oil enema, and care should be taken to prevent infection of the wound. Daily motions of the bowels from this time on should be secured so as to avoid any straining efforts.

The author of this operation has performed it a number of times for severe cases of prolapse, and thus far has had only one case of recurrence afterward, but this patient was cured by a second operation.

Mention should be made of ampu-

tation of prolapse, but it is a method seldom used except in those rare instances in which the prolapse is irreducible.

NON-MALIGNANT ULCERATION.

It is a matter of surprise that erosions of the mucous membrane of the rectum are not more frequently produced and become the starting points of ulceration, as a result of the irritation to which the bowel is exposed from the presence and passage of fecal matter as well as from infection of the tissues by pyogenic micro-organisms which are present in such quantities in the average intestinal tract. It is true that ulceration frequently exists and is not recognized; but, nevertheless, its frequency, compared with that of other rectal lesions, is rather infrequent.

SYMPTOMS.—Ulceration within the rectum, as a rule, occasions well-marked, though in no sense essentially pathognomonic symptoms. The same signs are often observed in cases of other lesions of the rectum. The doubts as to the nature of the trouble may readily be cleared by making a digital and specular examination. The symptoms noted are: pain, tenesmus, diarrhea (often alternating with spells of constipation), and discharge. These also suggest dysenteric attacks, and it is no unusual experience to see cases of ulceration treated for dysentery.

Cripps (*op. cit.*, p. 193) states that the degree of pain experienced is no indication of the severity of the disease, the suffering depending on the situation of the lesion rather than on its extent. Generally speaking, the nearer the anus it is situated, the

greater the pain. This is well exemplified in cases of irritable ulcers of the anus. In ulceration involving the anus, loss of control of the sphincters often occurs.

The diagnosis will receive due attention when the individual varieties of ulceration will be discussed.

ETIOLOGY.—Non-malignant ulcers of the rectum are usually classified into (*a*) the varicose; (*b*) the traumatic; (*c*) the dysenteric; (*d*) the irritable [the so-called fissure of the anus]; (*e*) the catarrhal, or follicular, and (*f*) those arising from general debility occasioned by Bright's disease, phthisis, diabetes, and starvation; also into (*g*) the tuberculous; (*h*) the chancroidal, and (*i*) the syphilitic.

The existence of the *varicose* and the *traumatic* varieties seems to be unquestioned by all authorities. It is true that varicose veins of the legs are often followed by ulceration, and that a similar condition of the hemorrhoidal plexus of veins is the precursor of ulceration of the rectum, which should be classed in the category of the predisposing causes of all ulcerations in this region. In all conditions which lead to ulceration primarily, the condition is attended by varicosity of the rectal vessels, which induces a stasis of the blood-supply, followed by congestion. Under these circumstances it is not likely that an ulcer of the bowel will occur without some form of traumatism.

The *traumatic* ulcer may be produced in a variety of ways, as from the introduction of foreign bodies through the anus; but much more frequently the initial laceration or abrasion is occasioned by hardened fecal masses, pieces of bone or wood,

nutshells, or some similar substance. Pressure of the fetal head during childbirth is a not unlikely cause. Retarded union following operative interference upon the rectum for the removal of hemorrhoids, polypi, etc., is another factor in producing ulceration.

The *dysenteric* variety, in the opinion of J. M. Mathews, is rare: He states that "if a long-continued irritation is kept up in the rectum from any cause, the result would be, of course, an inflammatory exudate, resulting, perhaps, in ulceration and stricture," but he states that, in searching for this as a cause, the evidence has not been such as to enable him to place it in the list as a cause at all for stricture of the rectum. What this distinguished author has to say upon the subject of dysentery as a cause of rectal stricture applies with equal force to ulceration. An attack of dysentery may, and often does, act as a predisposing factor in causing an ulceration of the bowel, but that we have a class of ulcers to which we can apply the term dysenteric I very much doubt.

The *irritable ulcer* of the rectum, known more commonly by the term "fissure of the anus," has been thoroughly reviewed.

Follicular, or catarrhal, ulceration may, according to Ball, occur in any part of the colon, but the seat of election is undoubtedly in the rectum and the sigmoid flexure. The solitary follicles become inflamed and disintegrated, and finally open upon the surface of the bowel, owing to the necrosis of the swollen tissue. Though small at first, these openings gradually enlarge, and small ulcers are formed, which do not tend to

heal, but spread, and finally involve the submucous tissue. These ulcers also spread by uniting. In some instances the muscular coat of the bowel has been perforated and the ulceration has extended into the bladder and the vagina.

Ulceration involving the rectum and arising from the *general debility* occasioned by Bright's disease, diabetes, uremia, and starvation requires no special description, as it presents no special characteristics.

The true *tubercular ulceration* of the rectum may be a primary process, but in the majority of instances it is a secondary manifestation of pulmonary consumption. These ulcers are caused by the disintegration of small tuberculous nodules deposited in the mucous and the submucous coats of the bowel. They are sometimes scattered and sometimes closely packed together. Such ulcers are usually of considerable size and are found in the rectal ampulla or at the anus. They are irregular in outline, more or less ovoid, with their long axis parallel to the vertical axis of the bowel and corresponding to the direction in which the vessels in this locality run. They have a peculiar appearance, somewhat difficult to describe. They do not secrete pus, but a thin, watery discharge, and are usually surrounded by a mucoid material.

Under the name of *lupoid ulceration*, which is now known as a rare and virulent form of local tubercular infection, Ball describes the so-called rodent ulcer as one in which the essential element is a chronic intractable form of ulceration in the neighborhood of the anus and genital organs. Cripps states that this dis-

ease is seldom met with in the rectum, and that few instances of its recurrence are on record. S. G. Gant has called attention to the fact that this variety of ulcer is frequently confused with cancer of the rectum and with tubercular ulceration, owing to the severe pain experienced, the amount of tissue destroyed, and its tendency to break out again and again, as well as its liability to increase in extent in spite of all treatment. Young and old persons are alike subject to it. The same authority states that this ulceration is not always rapid in its course, some patients living for years, while the disease slowly spreads and death finally ensues as the result of hemorrhage or from a diarrhea and its attending state of exhaustion. It is a superficial form of ulceration, and the character of the discharge is principally serous, containing but little pus.

The *chancroidal* form of ulcer of the rectum is rarely seen in this country. I have seen but one such case. Messrs. Andrews state that in the hospital of Saint-Lazare, in Paris, they were shown numerous cases of chancroid of the rectum and the anus, caused by the practice of sodomy. These authors have also met with a few instances of this disease in cases of retrovaginal fistula in which the virus entered the rectum through the fistulous opening.

Regarding the *syphilitic* forms of ulceration of the rectum, it may be said that, in this country, at least, the only common manifestation is the mucous patch. The diagnosis of this variety of ulceration may be confirmed by the employment of the Wassermann reaction and the discovery of the presence of spirochetæ. It

is my belief that the mucous patch exists more frequently within the rectum than is generally believed. In the late stages of syphilis a form of ulceration occurs in the rectum which often assumes extensive proportions and results in the formation of stricture of the bowel.

TREATMENT.—In dealing with all cases of rectal ulceration rest is of primary importance, for the healing process will not take place if the patient be permitted to follow the usual habits of life. The medicinal treatment must be adapted to the nature of the lesion as well as to the relief of any general disturbance. In cases of simple ulceration the use of an **enema of flaxseed-tea** is of advantage in cleansing the bowel and to procure an evacuation. A pint or more may be used once or twice a day. An astringent injection may be employed, such as **fluidextract of hydrastis**, 1 to 2 tablespoonfuls to 6 or 8 ounces (180 to 240 c.c.) of water; a solution of **nitrate of silver**, 2 to 8 grains (0.13 to 0.52 Gm.) to the ounce (30 c.c.). Insufflation of various powders may be used with benefit, such as **iodoform**, **subiodide** or **subgallate of bismuth**; **calomel** and the **subnitrate of bismuth**, equal parts, etc. In this condition I have found the following injection valuable:—

℞ *Fluid hydrastis*,
Fluidextract of ergot,
Compound tincture of
benzoin of each 2 dr. (8 c.c.).
Fluidextract of hama-
melis 2 oz. (60 c.c.).

M. Sig.: To be well shaken before using. One-half ounce (15 c.c.) at a time, to be injected into the rectum every day.

Pain can be allayed by the use of **iodoform suppositories**, 5 to 10 grains (0.3 to 0.6 Gm.) each, used every six

to twelve hours. Opiates are injurious and sometimes dangerous.

No plan of treatment with which I am familiar will do much toward permanently curing the tubercular ulceration. **Curettage** and the application of **iodoform** have been used with temporary success only. Similar results are given by most writers.

The **tuberculin** treatment is recommended by some authorities who claim marked benefit from its employment. J. M. Lynch, of New York, advises as the proper method of employing it as follows:—

Geometric Method of Administering Tuberculins.—To obtain an average proper increase of tuberculins, it is necessary that the increase be at all times a certain percentage of the previous dose,—usually 25 per cent. The first dose administered is $\frac{1}{100000}$ of a c.c. The dilution necessary to administer this small amount means that 4 bottles are needed, labelled respectively *A*, *B*, *C*, and *D*. By using $\frac{1}{2}$ c.c. of tuberculin and $49\frac{1}{2}$ c.c. of diluent (which is normal physiological saline solution to which $\frac{1}{2}$ per cent. carbolic has been added), a 1:100 dilution is obtained and is placed in bottle labelled *A*; 1 c.c. of solution *A* to 9 c.c. of diluent placed in bottle *B* produces a 1:1000 solution; 1 c.c. of this (contents of bottle *B*) added to 9 c.c. of diluent placed in bottle *C* represents a solution of 1:10,000; 1 c.c. of solution *C* added to 9 c.c. of diluent is placed in bottle *D* and produces a solution of 1:100,000. Of this solution *D*, 1 c.c. is the first dose; 1.25 c.c. solution *D*, second dose; 1.57 c.c. solution *D*, third dose; 1.96 c.c. solution *D*, fourth dose; 2.45 c.c. solution *D* is the last dose, but, as this quantity is too large

to inject, it is usual to make the dilution—instead of 1:100,000—1:50,000, thus administering half the amount, or, in other words, 1.26 of the 1:50,000, increasing the dose at this point by 25 per cent., and reducing the dilution so as to at no time give a greater amount than 2 c.c. By this method, Lynch claims that there will be the production of a negative phase, and that the patient will be producing a definite regular geometric increase in the opsonic index.

CONGENITAL MALFORMATIONS OF THE RECTUM AND ANUS.

The proportion of infants born with malformations of the lower portion of the intestinal track is comparatively small. Harrison Cripps states that 1 case occurs in about every 4588 births. So far as published reports show, males form the larger percentage of cases.

Malformations of the rectum and anus result from arrested development of the so-called gut-tract during the early stages of fetal life.

The most practical classification for the use of the general practitioner is that of J. M. Mathews:—

Congenital malformations of the anus: (1) narrowing or partial occlusion, (2) total occlusion, and (3) complete absence.

Malformations of the rectum: (1) partial occlusion, (2) complete obliteration, (3) unnatural termination, (4) complete absence of the rectum, and (5) communication with the vagina.

The symptoms are self-evident in cases of malformations of either the rectum or the anus. In all the varieties—except that of the partial

occlusion of the anus and in those somewhat rare cases in which the bowel opens into the vagina, urethra, or bladder, or in some abnormal, but external, surface of the body—there will be signs of total obstruction of the bowels, such as distention of the abdomen and possibly fecal vomiting. (See also TUMORS OF THE RECTUM AND ANUS.)

PROCTITIS.

Inflammation of the rectum may be caused by a variety of factors of which hemorrhoids, tumors, parasites, dysentery, and gonorrhea are the most common. The symptoms are those of inflammation in other regions, heat, fullness and pain, besides more or less marked tenesmus. The latter may be accompanied by frequent defecation of small quantities of feces containing mucus, pus, or blood. The inflamed mucosa of the rectum may prolapse. When there is ulceration, stricture of the rectum may follow. Ulcerative proctitis with stricture is generally of syphilitic origin, but may also be due to local tuberculosis or dysentery.

TREATMENT.—Mild cases are best treated by **rest in bed** and **liquid diet** to avoid rectal irritation, and **suppositories of opium and belladonna** if there is pain. Irrigations with a very weak solution of **silver nitrate** or of **argyrol** are very beneficial. When the ulceration is severe, as is often the case in gonorrheal proctitis, insufflations of **iodoform** and daily irrigations with a 1:1000 **silver nitrate** solution should be tried. If this does not suffice, the ulcer should be cauterized by means of **galvanocautery**. When stricture occurs, **dilatations** with bougies may be

tried, but **excision** of the stricture gives more lasting results.

PERIPROCTITIS.

Inflammation of the cellular tissue around the rectum is generally due to extension by infection of a disorder of the rectum, such as hemorrhoids, fistula, fissure, cancer, etc., or to a local traumatism by hardened feces, a foreign body, a piece of bone or fishbone ingested with the food, etc., or again to extension of an inflammatory process from neighboring tissues, the urethra, bladder, prostate, vagina, uterus, ovaries, etc.

Periproctitis may be *circumscribed*, an abscess forming first beneath the mucosa or the skin of the anus; either of these may open spontaneously and form a sinus. Or it may be *diffuse*, the inflammatory process involving a large area through rapid spreading, thus leading to extensive sloughing. Such a process is usually observed in weak and aged subjects and often ends in death.

An **ischiorectal abscess**, acute or chronic, may result from periproctitis. The acute form gives rise to pain, heat, swelling and redness, with brawny induration of the affected side of the anus. Chronic ischiorectal abscesses are usually tuberculous. These are painless until pyogenic germs start an acute abscess, which then gives rise to the symptoms of that disorder.

TREATMENT.—Circumscribed abscess when superficial may be treated by **incision** and **drainage**. In the diffuse form, the strength of the patient must in every way be sustained by tonics, especially **strychnine**, **iron**, and **nourishing food**. The abscess may then be treated by **free**

drainage and stimulation with **silver nitrate**. If the area is not too extensive, **bismuth paste** may be used. In acute ischiorectal abscess a **free incision** should be made and the cavity washed out freely with **creolin solution**, followed by **iodoform packing**. The same treatment is indicated in the chronic form.

STRICTURE OR STENOSIS OF THE RECTUM.

Stricture of the rectum may be caused by tumors of the neighboring structures or perirectal abscesses, wounds or ulcers of the rectum. Muscular spasm may cause temporary stricture. Sometimes a stricture is a congenital deformity. There are circumrectal strictures, caused by very fine adhesions or plastic bands in Douglas's *cul-de-sac*, which are postoperative in women. They may follow improperly performed operations for hemorrhoids, Whitehead's ligature, or excision. Amebic dysentery may be a cause, also syphilis, although systemic treatment is of no avail. Gonorrhea is believed to be the cause by some; tuberculosis is a prominent factor. Strictures may be valvular, annular, and tubular, all of which can ultimately so obstruct the intestine as virtually to arrest its functions as a canal.

The symptoms are at first those of constipation which becomes increasingly worse, the stools assuming the shape of ribbons or pipe-stems, according to the kind of stricture present. The intestine is dilated above the stricture; this may lead to the formation of a fistula. Examination of the rectum should be insisted upon; this may readily be done by means of the speculum and finger.

The pouch above the stricture is caused by the accumulation of feces which is evacuated by periodical attacks of diarrhea or enteritis; in some cases complete obstruction is caused. The stricture is sometimes the seat of pain and ulceration, and mucus, pus, or blood may be passed.

TREATMENT.—Gradual **dilatation** of the stricture with bougies, and the frequent irrigation of the rectum or **enemas** to evacuate retained feces are efficient measures in mild cases. In suitable cases **resection** of the stricture should be practised. In severe cases **colostomy** is indicated; where the stricture is long and tubular, an **artificial anus** becomes necessary. The general weakness of the patient should be taken into account in these cases and the ease with which the rectal wall is torn, the possibility of causing infiltration and abscess in the neighboring tissue should not be overlooked when operative procedures are undertaken.

TUMORS OF THE RECTUM AND ANUS.

BENIGN TUMORS.—The benign tumors are new growths whose cells are arranged in the same systemic order as the tissues from which they originate, with no special function and with a tendency to grow away from the parent tissue. Most of them arise from the mucous membrane or from the anal skin and are therefore epithelial in character. Sometimes they are of congenital origin, such as tumors arising from abnormalities of the mesenteric canal and dermoid cysts.

Adenomata, or **soft polypi**, are probably the most frequent form of

the benign neoplasms met with in the rectum. They occur with the same relative frequency in both of the sexes and especially between the ages of 3 and 12. They vary in size from that of a small pea to that of a large chestnut, although cases are on record in which the tumor has been considerably larger. Their shape is more or less globular or pyriform. The surface is usually lobulated and nutmeg-like. It is attached to the rectal wall by a narrow, but often elongated, pedicle. Arterial pulsation can frequently be felt within the pedicle, as it is through this stem that the blood-supply of the growth is furnished. The vessels conveying the same are often of fair size. This fact is of importance, as it may account for the excessive bleeding which occurs in spontaneous detachment of such tumors.

These tumors are sometimes multiple, involving the entire rectal mucosa or scattered about the intestinal wall. I have seen several such cases.

These growths closely imitate the normal mucous membrane in structure, though their glands are larger, more abundant, more branched and convoluted, and less irregularly disposed. They also ascribe their greater frequency in the rectum than elsewhere to the fact that this portion of the intestinal tract is more liable to irritation.

Fibromata.—These tumors take their origin from the submucous or connective tissue of the bowel, are more or less pedunculated, and vary with regard to their relative firmness. All of the very dense fibrous polypi that have been met with have been as large as an English walnut; they creak when cut, and the incised sur-

face is of a pale color. Such growths are considered quite exceptional specimens of this form of tumor. The small polypi so frequently seen in connection with fissure and with hemorrhoids are due to an hypertrophy of the upper extremities of the columns of Morgagni. Unstriped muscular tissue is sometimes found intermixed with the fibrous tissue of these growths, and, according to Cooper and Edwards, it may form the greater portion of the tumor. Usually these tumors are single, but occasionally they are multiple, and, in rarer instances, disseminated over quite an extensive area of the bowel. The surface of these growths is usually smooth, and they are apt to be pear-shaped.

Papillomata.—These growths are variously termed by different authorities as "villous tumors of the rectum," "villous polypus," and "granular papilloma." According to Ball, they are a rare form of rectal growth, resembling the villous tumor of the bladder in general appearances, with the slight difference, however, that the lobes in the growth occurring in the bladder are more filiform, while in the rectum they are flattened or club-shaped. They are composed of the papillæ of the mucous membrane, which have proliferated freely, and are covered with cylindrical-celled epithelium. Papillomata are attached to the wall of the bowel by a more or less broad pedicle, but they are occasionally sessile. They bleed freely and occasion more or less mucoid discharge. They may protrude from the anus.

Lipomata.—Tumors composed of adipose tissue have also been observed in the rectum.

Teratomata, or dermoid cysts, are very seldom found in this situation. They differ in no respect from the same growth as found elsewhere in the system.

Enchondromata, or cartilaginous growths, are said to occur in the rectum, but they must be extremely rare.

Angiomata.—These nevoid tumors are likewise of rare occurrence in the rectum, and when they exist may occasion considerable hemorrhage.

Cystomata.—Various cystic tumors may occur about or within the rectum, but dermoid cyst is the most authenticated variety found in this locality.

New Growths Arising from Parasites.—P. Lockhart-Mummery of London, Eng., calls attention to an infection of the rectum by certain parasites which give rise to outgrowths of the mucous membrane of an adenomatous character, and cites that the best known example of this condition is to be found in the multiple adenomata of the rectum produced by the ova of *Bilharzia hematobia*, which appears to occur only in Egypt as a result of bathing.

This same authority mentions a case of rectal tumor produced by *Oxyuris vermicularis*, and reported by Ruffar.

Angiomata.—Nevoid growths about the rectum differ in no particular from similar affections elsewhere except that they may ulcerate more readily, which is due to the bowel actions producing more or less irritation.

Angiomata may occasion severe hemorrhage. Such growths are rare and, when present, are often congenital.

SYMPTOMS.—There are no marked symptoms to be defined as peculiar to benign growths. A sensation of weight in the rectum may be experienced; shooting pains, distress in the loins or back, more or less tenesmus, and diarrhea, with more or less discharge of mucus and of blood, are often noted. The character and intensity of the symptoms are influenced by the size and position of the growth. If situated high in the rectum, but little, if any, inconvenience may be experienced. When, however, it is attached low in the bowel, the local discomfort is complained of.

The differential diagnosis of the varieties of rectal tumors has already been sufficiently dwelt upon. Piles are not pedunculated, and a prolapse should occasion no difficulty in diagnosis. In cases of polypoid growth an enema should be administered and the entire rectum examined by first passing the examining finger as high as possible into it, then sweeping the palmar surface around the mucous membrane from above downward. In this manner the polypus may be caught between the finger and the rectal wall if present. Otherwise the growth would escape detection by being pushed ahead of the examiner's finger.

Tumors of the rectum, especially when situated some distance up, may occasion intussusception and even prolapse of the bowel. Partial and even complete obstruction of the bowel may likewise be caused. Ulceration and extensive bleeding may also be produced.

TREATMENT.—The treatment of these tumors is essentially surgical. Prompt removal is the only safe ad-

vice to give, the actual cautery or the ligature being employed. Anesthesia may be required in some forms of this trouble before operative interference may be carried out. Small polypi may, with comparative safety, be twisted off with a pair of hemostatic forceps.

MALIGNANT GROWTHS OF THE RECTUM.

The rectum is one of the favorite sites for malignant growths. In this region, as elsewhere, cancer is viewed as an incurable affection, and is asserted to run its course in about two years. It usually occurs after middle life, though cases are recorded in which it attacked the very young, and, though believed to be more frequent among females, Messrs. Allingham state that in their experience many more men are victims to this disease, to which statement my experience would seem to lend emphasis.

VARIETIES.—The forms of malignant disease met with in this locality are: (a) epithelioma, (b) scirrhus, (c) various forms of sarcoma, (d) encephaloid, (e) colloid, and (f) melanotic. In those tumors in which much fibrous tissue is mixed with the newly formed glandular structures, the growth is hard and resistant; when the neoplastic tubules are in excess, and the fibrous tissue delicate and scanty, the tumor is soft and fungous, and corresponds with the description of medullary cancer. A gelatinous condition due to mucoid or colloid change affecting the cells has given rise to the term “colloid” as applied to such growths.

The three terms scirrhous, medullary, and colloid signify varying

conditions of a growth or parts of a growth composed essentially of glandular tubules and epithelial cells.

Cooper and Edwards subdivide the adenocarcinoma into three forms, which may be severally distinguished as (a) the *laminar*, (b) the *tuberous*, and (c) the *annular*. Their description of these varieties is as follows:—

“In the *laminar* form, which is the most common, a portion of the intestinal wall is infiltrated or thickened, the affected area varying in size according to the stage of the disease. The thickening appears to exist between the muscular and mucous coats, and it tends to spread laterally rather than either upward or downward. Its center is slightly raised, while the edges are beveled off. The growth is connected with and binds together all the tissues of the bowel, but at first is freely movable as a whole. After awhile the surface of the neoplasm gives way, leaving a ragged ulcer with characteristically infiltrated borders. The destruction generally begins near the center and extends toward the circumference; but sometimes ulcers form at several points on the surface. As the process advances, the infiltration is gradually eaten away; its remains may be recognized as nodules or papillary excrescences rising from the base or border of the ulcer. In later stages the base may be smooth, hard, and clean, being formed by cicatricial tissue and the remains of the muscular coat, while the edges are hard and raised, and either tolerably uniform or beset with nodular or papillary growths. Much connective tissue is developed beneath the base of the ulcer, and becomes constricted and puckered, as these changes are in

progress. The course of the growth is sometimes different, inasmuch as the deposit is only partially destroyed by the ulceration, and its remains sprout up and form tumors projecting into the cavity of the bowel. The ulceration sometimes has another result, viz., destruction of the coats of the bowel and perforation of adjoining viscera.

"In the *tuberos* form the growth projects into the bowel. Its consistence varies, being sometimes hard and firm and in other instances soft and fungoid. One such mass may be present; or there may be several growths of the same character, but varying in size. At first the mucous membrane, though firmly adherent to the tumor, remains intact, but is soon destroyed by ulceration, and a portion of the growth is then apt to project through the opening thus made. Sometimes the membrane gives way at several spots, at which nodules or larger portions protrude. Such outgrowths are soft and friable. Sometimes the destructive process is too rapid for the development of fungoid growths; when the surface gives way, the ulceration continues to extend deeply and superficially until the muscular coat is laid bare. The cancerous process invades the neighboring tissues and structures,—*e.g.*, bladder, urethra, or vagina,—and openings are made into these parts. The process again may extend toward the sacrum and involve the nerves and bones of the pelvis. Occlusion of the bowel by a fungoid mass is a less frequent result.

"In the *annular* form the growth begins as a deposit between the mucous and muscular coats, and extends laterally so as to involve the whole

circumference of the bowel, but does not spread upward to any great extent. The subsequent contraction diminishes the caliber of the bowel and causes a marked degree of stricture."

SYMPTOMS.—The early symptoms of cancer of the rectum are far from being characteristic. Indeed, it often exists for a considerable period before the patient is cognizant of any trouble. Frequently patients consult a surgeon about hemorrhoids or some minor affection of the rectum or anus, and it is only after a digital examination that the presence of cancer is recognized. Generally, the first sign experienced, in cases of this disease, is a sensation of uneasiness in the lower part of the back and along the inner sides of the thighs, with possibly a similar feeling within the rectum. At the end of a day's work this may be supplanted by actual pain of a dull, heavy character. The next and most usual symptom is morning diarrhea. As soon as the patient gets out of bed, or soon thereafter, he is obliged to go to the closet. He may or may not pass any fecal matter, but does pass a thin, sanious discharge, having a most characteristic odor. Later the bowels move several times during the morning and most of the stools consist of this sanious discharge. The color of the stools is such that most patients ascribe their trouble to piles, and the discharge is attributed to blood from the latter. Constipation may alternate with the attacks of diarrhea.

Pain is nearly always a very late symptom of cancer of the bowel; this depends, however, upon the rapidity of the growth of the neoplasm. As soon as the growth invades the anal

portion, or neighboring organs, or involves the sacral nerves, pain becomes a marked factor. Obstruction of the bowel and the straining efforts at defecation will tend to increase the pain.

The discharge varies in quantity in different cases and at various stages of the development of the growth. In the early stages the blood is probably brighter in color and is derived from the congested vessels in the neighborhood of the tumor, but later on the hemorrhage is due to ulceration and erosion, as well as to congestion. In some cases the constitutional effects are most marked. In nearly all cases there is loss of flesh and strength, but this occurs, in my experience, only in the late stages. Often the cancerous cachexia is not sufficiently marked, in the early stages, as to be very noticeable. In the late stages the liver is often enlarged. The lumbar and pelvic glands are usually involved, although this condition may not be so marked as to be readily distinguishable.

The duration of the symptoms varies in different cases and depends, to some extent, upon the age of the patient and the character of the neoplasm. In the young, the disease generally runs its course quite rapidly, and when the growth is soft its effects are more rapid.

DIAGNOSIS.—There are two conditions which are likely to be confounded with malignant disease of the rectum, one being benign growths and the other neoplasms external to the bowel.

Benign growths are generally pedunculated, cancers rarely so; benign growths, unless ulcerated, are bathed

in healthy, transparent mucus; cancers discharge offensive, chocolate-colored matter, the odor of the same being almost pathognomonic of malignant disease. Benign tumors are not friable, like malignant growths, nor do they bleed as easily.

Benign neoplasms spring from a soft, healthy mucous membrane, which glides freely upon the deeper coats of the bowel, while the malignant tumor grows from an indurated lump or patch in the bowel, which seems fixed or rigid. In suspected tumors, in which the diagnosis is at all obscured, a small specimen of the same may be obtained by scraping the tumor either with the finger-nail or a curette, and subjecting the excised portions to a microscopic examination (Andrews, *op. cit.*, pp. 112, 113).

PROGNOSIS.—The duration of the symptoms will prove of value in reaching a conclusion; the onset and progress of benign neoplasms being extremely slow. In malignant disease there is usually a portion of tolerably healthy mucous membrane between the growth and the anus, whereas in the non-malignant stricture this portion of the bowel is generally more or less infiltrated (Harrison Cripps, *op. cit.*, p. 383).

ETIOLOGY.—The causes of this disease are not known, and even its pathology is subject to dispute. The question of heredity is an open one, and probably if it be a factor it is one of only slight importance. Climate, as noted by the Messrs. Andrews, influences the tendency to cancer. These authorities state that it is clear that in this country cancer prevails most near the sea, and least of all at a distance from it; also, that, at

equal distances from the sea, it abounds decidedly more at the North than at the South. The germ theory, as applied to the origin of this disease, has some ardent advocates, but so far success in proving this to be more than a theory has not crowned the efforts of the microscopists.

TREATMENT.—The surgical treatment of this disease will first engage our attention because it is to such procedures that we must look for the most relief. If it were possible to recognize the existence of cancer at its earliest stages and to obtain consent for its radical removal, the prognosis of such operations would be greatly bettered, and the statistics would show, at least, a remarkable prolongation of life. Great relief from its most distressing symptoms would also be afforded.

It is frequently a hard matter to decide which of the surgical procedures is to be resorted to, the aim being to afford the greatest relief with the incurrance of the minimum risk. The recognized procedures are 4 in number: *extirpation*; *colostomy*, inguinal and lumbar; *posterior linear proctotomy*, and *curettage*.

Extirpation.—The ideal method of treating cancer of the rectum would be by extirpation, as is done in cases of the same disease when the mammary gland is the site affected; but unfortunately it is not often that the rectal neoplasm is discovered in time to permit the entire removal of the growth and of all glandular involvement; consequently, it is my belief that the cases in which this operation is indicated will be confined to a relatively small number of cases.

Kraske, of Freiburg, recommends a radical operation for the excision of

the rectum. Up to 1897 (Sammlung klin. Vort., 183, 184, '97) he had operated upon 80 cases, 15 of which died. The 80 cases divided into two series, the first of which occupies five years, during which the writer was perfecting the operation; it comprises 29 cases with 10 deaths, giving a mortality of 34.5 per cent. The second series, extending over the last seven years, includes 51 cases with only 5 deaths, being a mortality of 9.8 per cent.

The operation is as follows: The patient being placed on his left side, an incision is made starting from the second piece of the sacrum and extending down to the anus, in the middle line. The soft tissues are then carefully raised from the sacrum, the coccyx is excised, and the sacrosciatic ligaments are severed at the sacrum. The rectum is thus brought into the field of operation. If it is necessary to increase the field a portion of the left side of the sacrum opposite the third sacral foramen may be removed. Kraske does not favor sacral section above this level, nor does he recognize the utility of a temporary or osteoplastic resection, which some advocate with a view to prevent prolapse of the pelvic organs, owing to a presumed weakening of the floor of the pelvis. The resection of the cancer is begun by him with the division of the bowel below the tumor by opening it transversely; sutures are then placed in the upper cut surface for traction purposes. The patient is then brought into the lithotomy position, and the dissection proceeded with. Sometimes the peritoneum can be peeled off the bowel; but, if necessary, it must be opened, two fingers introduced, the gut pulled

down, and the operation proceeded with. Packing of the wound with iodoform gauze should be adopted to prevent infection, and need not be removed till it shows a tendency to become loose, about the end of the first week.

Mathews states that unless all tissues involved in the cancerous disease can be removed, an operation is useless. The rectum is contiguous to a large distribution of glands and lymphatics. Cancer situated above and not involving the sphincter muscle is often an insidious disease. When the mass has so far extended as to embrace the whole rectum, it is safe to infer that the infiltrative process has so extended that it has embraced structures which cannot be removed; hence to resect simply the mass in sight would avail nothing. If, on the contrary, the growth can be circumscribed, and the assurance had that all diseased structures can be removed, then resection, or rather extirpation, should be advised. Operation is much more preferable than to perform a colostomy in such a case. The latter can only be a palliative, if that; while the former anticipates a radical cure. Mathews avoids such operations as Kraske's if a lesser one will accomplish the purpose. Removing portions of the rectum by the simple circular incision and a careful dissection of the bowel with the fingers have been practised by him.

Colostomy.—Colostomy is quite practicable in a large number of instances, and the benefits derived from its performance are thus minutely described by Kelsey. "It relieves pain: does away with the constant tenesmus and discharge from the rectum, which by their exhausting

effects are the immediate cause of death; delays the development of the disease by preventing the straining and congestion of defecation; prevents absolutely the complication of intestinal obstruction, which is another cause of death; enables the patient to sleep, eat, and gain flesh, and often makes him think himself cured in spite of the plainest prognosis to the contrary. Instead of his passing his days and nights upon the commode, wearing out his life in his efforts to free the bowel from its irritation, he has one or perhaps two solid fecal evacuations from the groin in twenty-four hours." The benefits to be derived from colostomy are not exaggerated. It is the operative procedure indicated when a cancer has reached the stage of operative interference and has passed beyond the time when the surgeon reasonably expects an extirpation to afford a radical cure.

Posterior Linear Proctotomy.—I have never attempted to relieve a patient suffering from malignant trouble by means of this operation. In benign structures I have found the procedure a most excellent plan of treatment when combined with the subsequent use of bougies. Those surgeons who adopt this method for the relief of cancer speak highly of its efficiency, some going so far as to claim that it takes the place of both colostomy and excision.

Curettage.—In those cases in which the growth is within the lower three inches of the rectum and its character is such that extirpation is not possible, and colostomy is not at the time necessary and the growth not hard, considerable temporary benefit may be given the patient by resorting to

this operation. In selected cases it is followed by a diminution of pain, bearing-down sensations, and discharge, and the lumen of the bowel is enlarged.

In certain cases the combined operations of colostomy and of curettage will afford the patient much more relief than where one or the other procedure is individually adopted. It is true that only temporary relief is afforded by either of these operations, but in the majority of cases this is all we can offer the patient under any plan of treatment in vogue at the present time.

Röntgen Rays.—No doubt the favorable reports of the employment of the X-ray in other portions of the body led proctologists to hope that similar encouragement might follow its use on malignant neoplasms of the rectum. I regret to state that, in many cases in which it has been used, to my knowledge it has been to the patient's detriment. It is true that all of them were in an advanced stage of the disease, and had passed beyond the period when any hope could be entertained of relief from medical procedures. The characters of all the growths were of the adenocarcinomatous variety, and were situated within the bowel from two to three inches above the anus. The youngest case was 40 and the oldest 68. The treatments with the agents under consideration were all carried out by able and experienced radiologists. In every instance the patients became so noticeably worse, after periods of treatment varying from a few weeks to several months, that its cessation was advised. The occasion for the advice as to its cessation was the profound toxemia produced. The

effects, as noted in detail, were: At the end of a few weeks more uneasiness was experienced in the rectum and patients were obliged to go to the toilet much more frequently. Tenesmus was noticeably increased. These symptoms were followed, at varying intervals of time, by creepy or chilly sensations along the spine and, in some cases, by actual chills simulating those of a malarial character; by nausea more or less pronounced; by a diminution or marked loss of appetite; by an elevation of temperature, often amounting to two or three degrees above that normal to the particular individual; by a progressive loss of strength, frequently confining the patients to bed when previously they had been able to walk or motor; and finally, in all instances, a pronounced increase was noticeable in the cachectic appearance of these patients.

In several cases a colostomy was performed, much earlier, in my judgment, than otherwise would have been necessary had the disease been allowed to run its natural course. In all the cases the size of the growth was undoubtedly lessened, and this was appreciable even after a few treatments, but it was always accompanied by constitutional symptoms, as previously noted, of an unfavorable character.

Radium.—My experience with the use of radium has been very limited. In one case it was employed in conjunction with the X-rays. This was in a case of cancer complicated with quite large fibroids of the uterus. While this treatment was used, the fibroids rapidly dwindled in size, but within a week following the cessation of its use the tumors became as

large as ever. Two weeks later a large pelvic abscess formed, which fortunately ruptured into the rectum. In those few cases in which radium alone has been employed it has seemed to have a somewhat similar effect to that produced by the Röntgen rays. At present writing I am inclined to advise the exercise of great caution in its employment, and not to leave it in contact with the diseased area for a longer period, at the most, than over three hours. Treatment on alternate days is sufficient according to my present limited experience.

Medical treatment of cancer of the rectum presents but three points for consideration: the **daily evacuation** of the bowels, the use of some soothing **local antiseptic wash** to cleanse the parts, and the relief of pain and tenesmus. The first indication may be met by the employment of salines: **citrate of magnesia**, **Epsom salt**, or **phosphate of sodium**. The second by enemata of a 2 per cent. **solution of creolin**, or the same strength **solution of permanganate of potassium**. The third indication for a time may be overcome by the use of **iodoform suppositories** (10 grains of the drug in each suppository used, if necessary, every six hours). The use of opium should be avoided as long as possible. The **denarcotized tincture of opium** is the best preparation to employ.

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REFRIGERATION.—Refrigeration, or thermosteresis, is the process of abstracting heat, or of making or keeping cool; when carried to its limit congelation or freezing ensues.

The milder degrees are produced through the action of water of varying degrees of low temperature applied in various ways, evaporating lotions containing some medicinal agent, ice-bags or ice-caps, the mineral acids, etc. These milder degrees of refrigeration will be found treated under their appropriate heads and need not be considered here.

In the more intense forms of refrigeration—congelation or freezing—we may make use of volatile liquids like ether, ethyl chloride, rhigolene, etc., or the newer preparations, liquid air and carbon-dioxide snow. The use of the volatile liquids as refrigerants will be found under each remedy named, and it only remains to consider the uses of liquid air and carbon-dioxide snow.

PHYSIOLOGICAL EFFECTS OF COLD.—The application of cold to the living body causes congestion of the superficial capillaries and, later, their rapid and extreme contraction, with a lowering of the surface temperature. A moderate degree of exposure is followed by a reaction during which the capillaries become dilated, the circulation stronger, and normal body temperature restored. In weak or debilitated persons the reaction is either delayed or absent; generally there is a longer period of vital depression, attended by subnormal nutrition and followed by slow recovery.

Prolonged exposure to a low temperature may be followed not only by local and temporary vascular syncope, but local and even general devitalization; beyond this only the physical and chemical effects of cold obtain. Complete restoration of function never follows complete freez-

ing of a tissue or organ; the devitalized portion becomes necrosed and sloughs off, as in frost-bite and gangrene. When the cold is less intense, permanent dilatation of the capillaries is apt to follow, associated with paresthesia and, perhaps, pruritus, as in *pernio*, or chilblain.

Continued exposure of the body to intense cold causes a shriveling and lividity of the skin, muscular weakness and rigidity, mental symptoms, drowsiness, confusion, coma, and, finally, death. These effects have been mistaken for those of alcohol, and the error is more easily made if the person has been indulging in alcohol previous to his exposure.

PATHOLOGY OF COLD.—The pathological appearances of general exposure to cold are: a waxy anemia of the surface with bright-red patches on the more exposed parts of the body. There is marked congestion of the internal organs, and reddish-brown stains are found along the course of the superficial blood-vessels, due to disintegration of the blood-cells and diffusion of the coloring matter through the vascular walls.

Local freezing causes an occlusion of the blood-vessels with subsequent anemia, necrosis, and atrophy of the epithelium in proportion to the intensity of the application (Bowen and Towle).

LIQUID AIR.—Liquid air was first made in appreciable amount by Dewar, of England, in 1877. A. Campbell White, the first to use it as a therapeutic measure, published the first report of his work in 1899. In the preparation of liquid air the atmospheric air is first dried and purified by chemical filtration, and then liquefied by repeated compres-

sions (at first 100 pounds, then 800 pounds, and, finally, at a pressure of 2000 pounds to the square inch) and a cooling device.

Liquid air looks like water and can be poured like it. It feels like water when the finger is thrust into it and hastily withdrawn; the finger, however, comes out dry. When it is poured on the floor, it strikes with considerable noise and at once vanishes as steam without wetting the floor. Seen through its glass container, it appears to be gently simmering, and a delicate vapor floats over the mouth of the flask. The temperature of liquid air is -422.5° F. (-252.5° C.). It cannot be corked up as, in its effort to resume its natural state as atmospheric air, it develops such great expansive power that nothing but the strongest steel cylinder could be used. It is marketed in what is called a "Dewar bulb," a flask so blown that one flask is inside another with a vacuum between. This flask is placed inside a case, and closely surrounded with wool to prevent too rapid evaporation. The mouth of the flask is partially stopped with a loose plug of absorbent cotton, so as to allow the escape of the small amount of vapor that is constantly arising from the liquid. A liter (quart) of liquid air may, in this way, be kept for several days.

Method of Application.—Liquid air is applied by means of pledgets of absorbent cotton wrapped around wooden applicators. These pledgets may be of any size or shape, but sufficient cotton must be used that they will absorb enough liquid to produce the desired effect. In very small lesions a larger surface than

would otherwise be necessary must be frozen, because very small pledgets would not hold enough liquid. The pledget is dipped into the liquid air, withdrawn, given a sharp shake to remove the excess of liquid, and is then applied to the affected part with pressure sufficient to produce the desired effect.

CARBON-DIOXIDE SNOW.—

Carbon dioxide, or carbonic acid gas, is manufactured extensively, for charging soda-water fountains, by the action of sulphuric or hydrochloric acid on calcium carbonate (marble-dust), and is purified by passing it through a solution of potassium permanganate. The gas is liquefied under pressure (900 pounds to the square inch) with a cooling device similar to that used in liquefying air. As the liquefied gas is under less pressure, it is safely delivered in steel cylinders. When the liquid gas is allowed to escape its temperature falls to -23.8° F. (-31° C.). By mixing it with ether and allowing the mixture to evaporate, the temperature may be lowered to -148° F. (-100° C.). Dr. W. A. Pusey, of Chicago, was the first, in 1905, to suggest the possibilities of liquid carbon-dioxide gas as a substitute for liquid air; the idea and technique were further elaborated by S. Dana Hubbard and George Thomas Jackson, of New York, and others.

Method of Application.—To make snow for freezing purposes the cylinder holding the gas must be placed on a stand, or fastened to a wall bracket, and inclined at an angle of about 45 degrees to prevent the freezing of the escape valve; this position also favors the making of a soft and easily molded mass of snow. The

valve end of the cylinder should be firmly fastened by a strap, as, occasionally, the valve is hard to turn. The cap covering the vent-hole is removed and the snow may now be made. When a portion of the liquid carbon dioxide is allowed to escape, a part resumes its original form of gas or vapor, and the remainder is frozen, or converted into snow, by the intense cold produced by the rapid change of state of the carbon dioxide from a liquid to a vapor, according to the well-known laws of latent heat; the snow may be caught and retained by some porous material wrapped around the vent, through which the vapor can pass. Carbon-dioxide snow is, therefore, simply frozen or solidified carbon dioxide.

To gather the snow Pusey first used a chamois bag made by taking a piece of chamois skin, making several turns with the straight edge about the hole, and then folding the piece back on itself. Kimball, of Boston, uses a chamois cylinder about two inches in diameter by eight inches long, with tapes at one end and open at the other. This can be rolled up, and any quantity of snow can be collected in it. Blotting-paper, without glazing, rolled up in a tube may be used, the end being lightly stopped with absorbent cotton. Hubbard, of New York, uses a length of brass pipe, large enough in diameter to fit around the vent-hole, cut longitudinally in two parts, joined on one side with a piano hinge, perforated with a number of holes, and covered with chamois skin on both surfaces. The chamois is two or three inches longer than the tube so that it may be turned back over the latter. Hubbard has obtained the

best result by wrapping a little absorbent cotton about the vent-hole, and placing a plug of cotton in the farther end of the tube before applying it to the vent-hole.

When one is ready to make the snow the chamois bag or the Hubbard apparatus is applied to the vent-hole and the gas is allowed to escape by turning the nipple at the extreme end of the cylinder with the small wrench that comes with it. The gas is allowed to escape, first slowly and then more rapidly. A sound as of gas escaping under pressure is first heard. Some sputtering and jerking of the bag or tube may occur, but need occasion no alarm. Then a bluish gas will appear and in five or ten seconds fine snowflakes will blow through the chamois, showing that the apparatus is full of snow. The gas is then turned off and the apparatus removed. The snow may now be molded in any shape by working it in the bag, or packing it in sections of iron or brass pipes of various diameters. Ear specula make good molds for small lesions. The use of square-shaped molds is advised by Pusey, so that if more than one area is to be frozen the edges may not overlap. The temperature of the snow is -108.4° F. (-78° C.), yet it can be safely handled and molded if the fingers are protected by the chamois or by a glove. Snow prepared in the Hubbard apparatus is compact, and can be pared with a knife to any size or shape. When drawing the gas it is best to wrap a towel around the apparatus to further protect the hands. A crayon of carbon-dioxide snow can be held in the palm of the hand for several seconds without freezing the tissues, owing

to the formation of a layer of carbon-dioxide gas (Crook's layer) between the snow and the skin. Apply pressure and freezing begins at once.

EFFECTS OF FREEZING.—The effect on the tissues is the same whether liquid air or carbon-dioxide snow is used, save that, as the air is more than three times as cold, the effect is more rapidly produced. The snow should not be mixed with ether, as suggested by the Mayo brothers, or chloroform, but the cone should be lightly dipped into it just previous to applying it to the skin (Hubbard and George T. Jackson).

When the snow crayon is placed on the skin, with slight pressure, there is a sizzling sound and the area of contact is at once frozen hard, turns white, and when tapped with a pencil emits a sound like that produced by striking a board. The amount of pressure used and the duration of contact will determine the depth of the freezing. A superficial lesion will require light pressure and short contact. With moderately firm pressure the part will be frozen stiff in ten seconds. After a few minutes the part will thaw, a zone of redness will encircle it, and presently vesicles will appear on it. A slight crust will form in a day or two, which on separating will leave a faint, soft scar. This may entirely disappear. With firmer pressure the parts will be frozen deeper in thirty seconds. Thawing will be slower, and a tense bulla will appear in from six to eight hours, which will, later, shrink and become a dry crust leaving a slight scar. The crust is always dry and the scar soft and pliable after either liquid air or carbon-dioxide snow. When dipped into

ether or chloroform the duration of contact must be less, as the effect is increased. Remove all crusts before freezing; cover mucous surfaces with a layer of gauze to prevent the cotton pledget from freezing fast, when liquid air is used. Bullæ may be pricked, but crusts must not be removed. Freezing should not be repeated, if necessary, until the effects of the first freezing are fully recovered from.

RELATIVE VALUE OF AIR AND SNOW.—If liquid air could always be obtained it would be preferred because of the ease of its application, the rapidity of its action, and its comparative painlessness. The uncertainty of the supply and its high cost make the use of liquid air almost prohibitive.

The advantages of carbon-dioxide snow are: It can be easily obtained; a cylinder can be kept in one's office, or the snow can be made in any drug-store where the soda-water is charged on the premises; it can be used on small lesions, as, unlike liquid air, no larger surface than is necessary need be frozen, as the mass or crayon of snow may be pared down to any size.

THERAPEUTIC USES.—Pusey gives three indications for the use of carbon-dioxide snow: (1) to produce a simple inflammatory reaction; (2) to produce destruction of certain tissues by interstitial scar-tissue formation; (3) to produce immediate destruction of tissues by freezing. He emphasizes the fact that its usefulness lies chiefly in the fact that an interstitial sclerosis of the tissues (scar-tissue formation) can be produced by it, without destroying all of the tissues in the area treated.

While freezing is for the most part

used as a destructive agent, liquid air may be used to stimulate **ulcers**, as suggested by White, and for producing **local anesthesia**. For the latter use it acts more promptly than ethyl chloride and a superficial freezing is sufficient. This anesthetic action is available to relieve the pain of **herpes zoster**, in which case the cold is applied to the spine. In the treatment of **boils** and **carbuncles** White applied the liquid air in the form of a spray from a bottle with a cork perforated to receive two glass tubes of unequal length. The finger placed on the shorter tube, air comes in a fine spray from the other tube that dips below the surface of the liquid and has the other end bent downward at an angle, the air being forced into the openings of the carbuncle or boil, and the surface being slightly frozen.

In affections of the skin carbon-dioxide snow has a wider range of usefulness than the X-ray; it will do more and with greater certainty (W. S. Gottheil). G. T. Jackson and Hubbard advocate freezing by carbon-dioxide snow as the best treatment for **lupus erythematosus**; it is not necessary to freeze deeply. When the cone is dipped into ether, fifteen seconds are usually sufficient. **Nevi** and **angiomata** yield readily to freezing, although the latter may require a second application. **Port-wine marks** are best treated by applications of liquid air; other forms of **vascular and pigmentary nevi** are readily removed by either remedy. Firm pressure for one or two minutes and deep freezing are required in **hairy nevi**, to insure destruction of the hair-follicles. Morton strongly advises the use of the snow in **chronic localized eczema**. **Epithe-**

liomata, especially of the rodent-ulcer type, are cured more rapidly by the use of the snow, with less pain and scarring than by any of the caustics; firm pressure for one or one and a half minutes is necessary; in inoperable cases it should always be tried. Keratosis senilis, warts, papillomata, tattoo marks, powder stains, hypertrophied scars, keloid, tuberculosis verrucosa cutis, chloasma, and scrofuloderma have all been cured by freezing.

The treatment of trachoma by the use of the snow crayon is a somewhat delicate operation, several applications of quite short duration being necessary to cause disappearance.

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RELAPSING FEVER. (Famine Fever; Spirillosis; Febris Recurrens; European Relapsing Fever).—**DEFINITION.**—An acute infectious fever caused by Obermeier's spirillum (*S. recurrentis*) characterized by a febrile paroxysm of about six days' duration, followed by a remission of about equal length, and one or more relapses of both paroxysm and remission. Relapsing fever has been seldom met with in this country since 1869, when it occurred in New York and Philadelphia in epidemic form. The term relapsing fever, however, includes several diseases caused by different spirilla. The European relapsing fever is caused by *Spiroschaudinnia recurrentis*, the North American by *S. novyi*, the West African by *S. duttoni*, and the Indian by *S. carteri*. The symptoms and treatment of the European and American varieties are very much the same.

SYMPTOMS AND DIAGNOSIS.—The period of incubation is from four to ten days or less; and in this stage malaise or fugitive pains may appear. The invasion is abrupt and may be marked with rigors or with slight shivering. With these are frontal headache, vertigo, severe pain in the back and joints, chills,

fever, and, particularly in young subjects, nausea and vomiting. Convulsions are occasionally observed in children. The pulse is rapid—110 to 140 or more, and the temperature is high—105° to 106° F. (40.5° to 41.1° C.), on the first or second day. This parallelism is important since it serves to differentiate relapsing fever from influenza, which disease it resembles. An attack of malarial fever is also suggested, the spleen being more or less enlarged almost from the start and profuse sweating being common. But the delirium which accompanies a high temperature, the prolonged duration of the paroxysm, the gastric symptoms, which are usually severe, serve to invalidate such a diagnosis. Typhoid fever is simulated in many instances, especially when petechiæ, which are sometimes observed, are present; but the rapid decline of practically all active symptoms after a few days clearly indicates the absence of this affection. Again, intestinal symptoms, except toward the crisis, are uncommon. Many manifestations of varying nature may appear in the course of the disease: jaundice, cough, parotitis, cervical adenitis, orchitis, edema of the feet, monarticular or polyarticular inflammations, laryngitis, and glossitis. Again, various eruptions may appear—roseola, purpura, urticaria, herpes, and the rashes of scarlet fever and measles. Hematemesis, hematuria, and epistaxis are occasionally noted. The most serious complications observed are pneumonia and acute nephritis. The intensity of the symptoms steadily increases, as a rule, until the crisis appears—from three to seven days after the onset of the access. Diarrhea and sweating are often the first signs of the remission; a rapid decline of temperature, to the normal or below, follows, and convalescence begins.

In about one-third of the cases the fever does not return; in the remainder a new attack appears after a week's comparative comfort. The previous symptoms once more prevail, and are followed, as in the former experience, by a sudden crisis, a period of repose, and a third attack. As a rule, the disease ends here; but two more recurrences may appear, each successive attack increasing the

patient's exhaustion. In weak and aged individuals death may thus be brought about; but, as a rule, the fatal issue occurs during or at the end of the first access. Deaths from rupture of the spleen have been reported. The fatality of the disease is small, being but 1.26 per cent. during the epidemic which occurred in Moscow in 1894, but it may reach 6 per cent., as was the case in the St. Petersburg epidemic.

Ulcerative conjunctivitis, various forms of paralysis, and the various complications occurring after exanthems are occasionally observed to follow the affection.

ETIOLOGY AND PATHOLOGY.—Poverty, filth, insufficient or poor food, and other unhygienic conditions prepare the system for the invasion of the organism, a spirillum, or spirochete. This micro-organism, a filamentous spiral, may readily be recognized in the blood, during the paroxysm, by its rapid movements among the red corpuscles. It disappears with the attack, and is superseded by what is thought to be its spores.

It is thought that the medium of transmission is through suctorial insects. Tiotin studied this question during an epidemic which occurred at Odessa, Russia, in which 10,000 cases occurred. Hungry bedbugs were allowed to bite a monkey that had the spirilli in his blood, and the blood of the insects was then examined. Organisms were found that were active for some time. A healthy monkey being then inoculated with this blood by injection, rapidly developed the disease. Mackie's experiments in a Bombay epidemic point also to lice as carriers. There is some evidence that fomites may carry the disease.

The morbid changes are not very marked; the spleen may, however, be greatly enlarged and soft, and the other viscera show evidences of degeneration. Nathanson noted changes in the cardiac ganglia, the degenerative process involving the protoplasm and the nucleus.

Sex and age seem to influence the development of the disease somewhat, as the disease is most common in young adults between 15 and 25 years of age; a larger proportion of males than females are affected. It is thought to be conta-

gious and to afford no immunity against subsequent attacks.

TREATMENT.—Quinine is absolutely useless, except as a tonic during convalescence, and no medicinal treatment seems to curtail the attacks or prevent them. **Symptomatic treatment**, coupled with **hygienic measures** and **nutritious**, though easily digested food are indicated. An **antispirechetic serum** (H. Löwenthal) has recently been used with apparent success (131 cases with but 1 death). Ardin-Delteil, Negre, Mouzels, and Reynaud recommend **salvarsan** or **neosalvarsan** in massive doses (gr. x—0.6 Gm.) and consider it almost a specific. During the intermissions the patient should remain indoors for at least 10 days, early exposure or sudden exertion predisposing one to a relapse. The treatment of a relapse is the same as that of the primary attack. S.

REMITTENT FEVER. See **MALARIAL FEVERS.**

RENAL CALCULI. See **KIDNEYS.**

RESECTIONS, AMPUTATIONS, AND CINEMATIC PLASTICS. —RESECTIONS.

Resection or excision of a joint means the removal of the articulating ends of the bones with the cartilages and synovial membrane, and is necessitated when the articulation is destroyed by injury or disease (usually tuberculosis), or by irreducible luxations or other forms of ankylosis where a more useful limb is desired. The limb is always shortened, and, in the young, if an entire epiphysis is removed, subsequent growth is interfered with. Resection of the joints of the lower extremity, and others in which the greatest growth occurs and in which shortening would cause inconvenience, should be avoided if possible. As a rule this operation should be limited to adult patients, and to the most severe cases of joint disease, in which mechanical treatment has failed, when there are large sequestra, where drainage and erosion will not meet the indications, and when a rapidly failing general condition demands this operation. It should al-

ways be one of the operations of last resort, in the same class with amputation.

When normal bone is removed to get at deeper parts, as in certain operations upon the jaws and the skull, it may be only partially separated, to be later replaced and attached; this is called **osteoplastic resection**. When an excision is made of a portion of the shaft of a bone, it is one **in continuity**; when of a joint extremity, **in contiguity**. If performed for injury and within a few hours thereafter, it is **primary**; if in the period of local disturbance during and after resection and before suppuration, it is **intermediary**; if after suppuration has occurred, **secondary**. Intermediary resections are not advised.

METHODS OF RESECTION.—Two general methods of resection are recognized. In the **subperiosteal or conservative method** the periosteum, joint capsule, and the attached ligaments and tendons are preserved. This is the ideal operation, since bone may be regenerated from the periosteum, and the joint movements retained by the muscles and their attachments. This method can, however, be rarely utilized for the reason that the ligaments, tendons, and capsular tissues are usually implicated, and in certain joints like the elbow new bone growth might inhibit free motion in the joint.

In the second or **radical method** the periosteum is not spared. The incisions are made so as to enter the joint by the most direct route and with the least injury to the contiguous tissues. Drainage is almost always a necessary feature of this method, either by gauze or rubber tubing.

SPECIAL RESECTIONS.

UPPER JAW.—Removal of the superior maxilla may be required on account of disease, non-malignant or malignant (sarcoma or carcinoma), or in the course of the removal of retromaxillary tumors. Though a bloody operation, it is singularly free from danger, the soft parts unite rapidly and the deformity is slight, a dental plate relieving the latter in large degree. By this operation sarcoma may often be cured or recurrence long postponed and in carcinoma the patient is

made more comfortable; life is not prolonged, and at times it is shortened.

Technique.—The bone is exposed by an incision over the infraorbital ridge from the malar bone to near the inner canthus, then along the side of the nose around the ala to the median line, and down through the middle of the upper lip. The flap so formed is reflected outward and dissected off the bone, and the free hemorrhage arrested by hemostatic forceps, pressure, and hot water. The malar bone is cut through with a fine saw, and later the ascending process close to its union with the frontal. The mucous membrane of the roof of the mouth is divided with a knife in the median line as far back as the soft palate, and laterally between the hard and soft palate, and the horizontal plates of the two maxillæ are separated from above downward with the saw. The bone is then removed with the lion-jaw forceps, or if, as frequently happens in malignant disease, the posterior wall is left behind, it can easily be removed. When not diseased, or when removal is not necessary to secure more room for further work, the orbital or alveolohorizontal plate may be left, the bone being sawn through just below the one or above the other; it is generally necessary, however, to remove the latter. Bleeding vessels having been ligated and general hemorrhage arrested, if necessary by actual cautery, the soft parts are replaced carefully along the line of incision and secured by fine sutures, the cheek-cavity filled with plugs of cotton or gauze to prevent oozing and to support the flap. A dressing of antiseptic gauze, covered with absorbent cotton and secured by a light bandage, is applied externally. The operation may be done through the mouth if only the lower part of the bone is to be removed.

If done to facilitate the removal of a pharyngeal growth, only the upper or inner bony attachment (malar-frontal, frontal-intermaxillary) should be divided, and the bone turned downward or outward, to be later replaced and reunited. The soft parts are not removed from the bones, but only incised at the point, the external portion acting as a hinge upon which the parts are turned back.

LOWER JAW.—Resection of the inferior maxilla is done for injury and for disease and may be in continuity, or of one-half, or of the whole. If in continuity and unilateral, it can often be done through the mouth, the soft parts being carefully drawn aside and the bone divided with a straight or chain saw, or even with cutting or gouge forceps. If in continuity and extensive, or if involving a half or more of the bone, an external incision of proper length should be made, and just below the lower border of the bone. The lower lip and the soft parts of the chin may or may not be divided in the mesial line, according as circumstances demand. If the middle portion is removed, all the attachments to the genial tubercles are secured, and tendency of the tongue to fall backward must be prevented by passing a ligature through it until the adhesions are sufficiently firm to prevent this accident.

Technique.—In resecting the half or the whole of the inferior maxilla, after separating the external and internal soft parts, well back toward the angle of the jaw, the bone is divided in the mesial line and firmly held off while the soft parts are further separated up to and including the coronary process. Disarticulation may now be effected, either by pulling or by a few cuts with the knife or scissors kept close upon the condyle. The periosteum should be preserved when the resection is done for disease unless the disease is malignant; division should be made through the body or at the base of the processes, whenever the object of the resection can be thus attained.

CLAVICLE.—Removal of a part or the whole of the clavicle may be done for disease, usually sarcoma. When done for other cause than malignant disease, and it has been possible to save the periosteum, regeneration of the bone, sometimes nearly perfect, may be looked for.

Technique.—The bone is exposed by a longitudinal incision, the soft parts being carefully but rapidly dissected off, and is divided internally to the affected area or disarticulated at the sternal junction, raised and cleared positively as far as required toward or to the scapular attachment, and there disarticulated or sawn

through. Hemostatic forceps are necessary to check the hemorrhage, often profuse when malignant disease is present. There is little danger of wounding the deep vessels and nerves, if the knife is kept close to the bone and the diseased mass.

After providing for drainage, the edges of the external incision are carefully coapted and sutured, and an antiseptic dressing applied, the arm being secured to the side.

Death may follow this operation from sepsis, shock, hemorrhage, or, later, from recurrence of the malignant affection.

SCAPULA.—Partial or complete removal of the scapula may be necessary for necrosis consequent upon injury, a benign or malignant tumor, the latter requiring complete excision, although a partial removal has been followed by no recurrence. When done for necrosis the operation is quite easy and simple; when for osteosarcoma, it is often difficult and attended by danger.

Technique.—In complete resection a single vertical incision may be made on line a little posterior to the middle of the spine and the soft parts reflected anteriorly and posteriorly; or an incision may be made along the whole posterior border, inclining forward at the upper end and forward and upward for a short distance at the lower end, following the anterior border, with usually an associated one over the course of the spine. The soft parts are then turned aside and the spinal muscles saved or left attached to the bone, depending whether the resection is not or is for malignant disease, the superior angle and adjacent upper border are freed from their attachments, then the posterior border and inferior angle, hugging the bone closely. The anterior surface is then cleared, after lifting up the scapula, and then the anterior border toward the glenoid fossa, the dorsal and subscapular arteries being ligated when reached. The acromion process is freed, the attachments of the scapular muscles divided close to the humerus, the coracoid process separated from its ligaments and muscles, and the glenoid fossa cleared. The bone is then lifted out, hemorrhage arrested, drainage provided for, the flaps

adjusted and sutured, and a compressing and retaining dressing applied.

SHOULDER.—Resection of the shoulder-joint is indicated in cases of severe injury, especially gunshot, rarely for compound fracture or relief of deformity. It may be made through an anterior oblique incision, three or four inches long, extending from the coracoid process downward and outward along the anterior border of the deltoid muscle, the patient's shoulder being raised, and the patient lying in the dorsal position, close to the edge of the table. The pectorodeltoid groove is opened, the cephalic vein and the pectoral muscles are retracted inward and the deltoid to the outer side, thus exposing the tendon of the biceps, at the outer side of which the joint capsule is opened. The elbow is next depressed, the humerus rotated inward, the supra- and infra-spinatus and teres minor are separated from the greater tuberosity, and the subscapularis from the lesser tuberosity after rotating the humerus outward. The tendon of the biceps is then reflexed by flexing the elbow, and displaced inward and the head of the bone luxated through the wound and divided with a saw. When the glenoid cavity is involved, the diseased bone is removed with a curette, or as a sequestrum. The arm, over an axillary pad, is bound to the chest, to prevent subcoracoid dislocation of the end of the humerus. As soon as the sutures are removed passive motions are begun.

ELBOW.—Resection of the elbow is indicated in certain cases of compound fracture, especially gunshot, of tuberculous disease, of old unreduced luxation, or of bony ankylosis. The incision is made upon the posterior surface of the joint in the median line from a point two inches above the articulation to one at or slightly below the line of junction of the olecranon with the shaft, or along the outer border of the triceps to the level of the epicondyle, and then downward and inward across the olecranon. The joint capsule is then opened and the soft parts dissected off on each side, preserving the periosteum if possible, until the condyles are well bared. Care must be taken not to injure the ulnar nerve. After flexing the forearm the lower end of the humerus

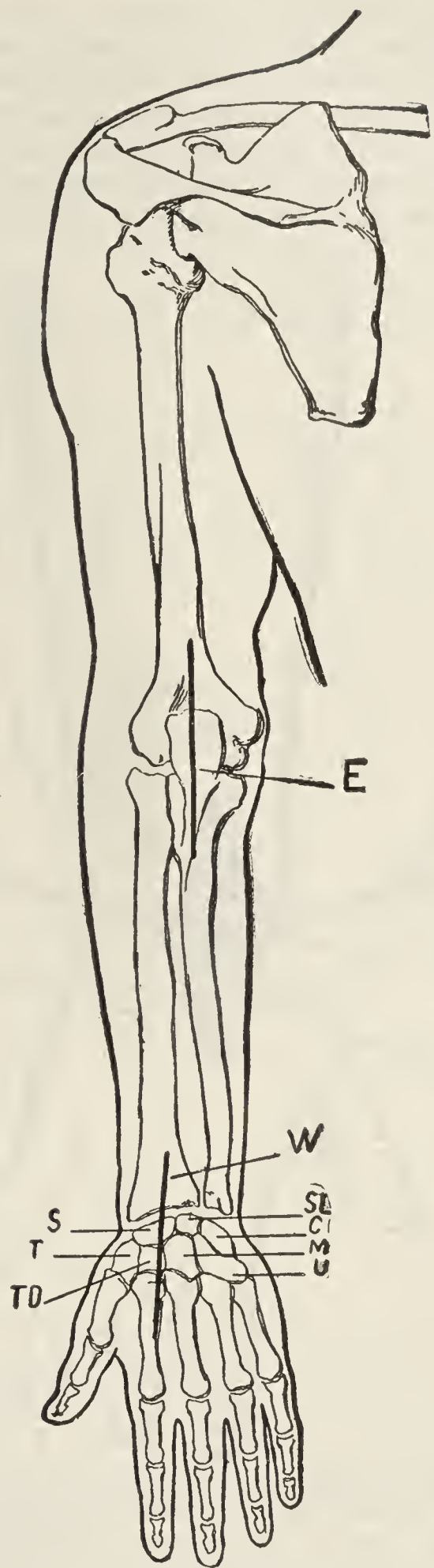


Fig. 1.—Left Arm, Posterior View. *E*, incision for resection of elbow-joint; *C*, cuneiform; *M*, os magnum; *S*, scaphoid; *SL*, semilunar; *T*, trapezium; *TD*, trapezoid; *U*, unciform; *W*, incision for resection of wrist-joint. (McGrath.)

is cleared, delivered through the wound, and sawn off; the upper ends of the radius and of the ulna are similarly treated. Instead of dissecting the soft parts from the

epicondyles and the upper edge of the olecranon, these bony surfaces may be chiseled off and turned aside without disturbing their muscular attachments. If a large amount of bone is removed, and a movable joint is improbable, the sawn surfaces may be united by wire or pins

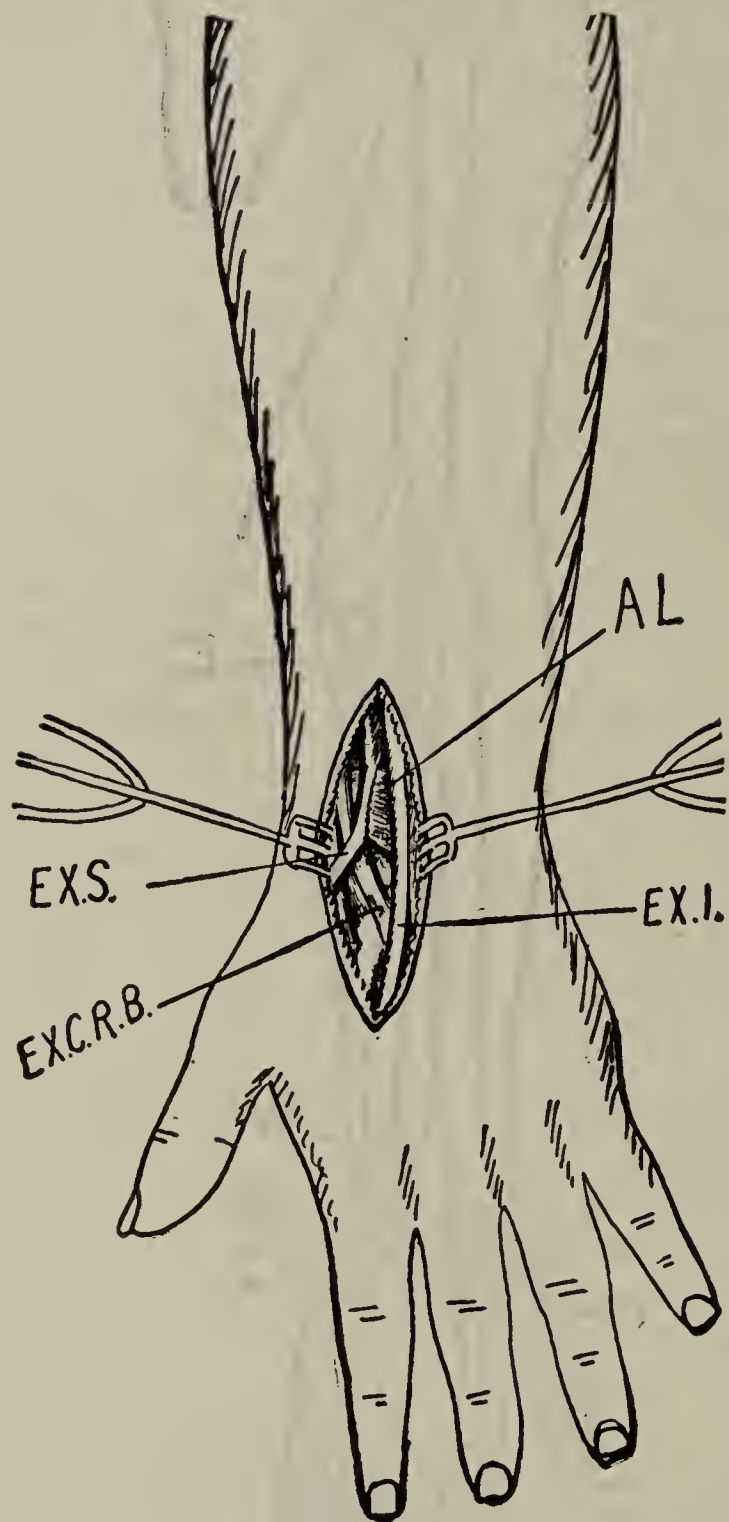


Fig. 2.—Resection of Wrist-joint. *AL*, annular ligament split to show the tendons of extensor secundi (*EX.S.*) and extensor carpi radialis brevis (*EX.C.R.B.*); *EX.I.*, tendon of extensor indicis. (McGrath.)

or a mortise and tenon joint may be formed of the ulna and humerus. If but little bone has been removed, more or less restoration of the functions of the elbow may be expected, at times so much as to allow the hand to be laid upon the shoulder. An internal angular splint may be placed on the forearm, to be retained

for from seven to ten days, passive motion being then begun in the suitable cases.

WRIST.—Resection of the wrist is most often necessitated by tuberculous disease, affecting chiefly the carpus; more rarely by extensive injury, usually of the lower end of the bones of the forearm. The method will vary according as the resection is done for disease or injury. In the latter case lateral incisions down to or just below the joint level will suffice to give free access to the bone and allow its removal with small danger to the soft parts.

When the operation is done for disease, the carpal bones cannot be so easily reached nor removed without serious risk to the nerves and vessels. Three methods are suggested: a single long median dorsal incision, two lateral incisions over the dorsal surface of the wrist, or a transverse straight or curved division of the tissues covering the back of the wrist. The last affords readiest access to the diseased bones, but is objectionable because the tendons are necessarily severed; these severed tendons may, however, be sutured and good repair and perfect function be obtained. Of all resections, that of the wrist is the most unsatisfactory.

If the single, long, median, dorsal incision is preferred, as being easier of execution and disturbing the tendons least, it may begin at the middle of the radial border of the metacarpal bone of the index finger, and be carried upward, between the tendon of the long extensor of the thumb and that of the extensor indicis, to the dorsum of the radius between the extensor indicis and the short radial extensor of the wrist, the soft parts covering the carpus being carefully lifted and turned aside, and the periosteum being preserved as far as possible.

INTERPHALANGEAL JOINTS.—A lateral incision on the side of the joint and the division of the lateral ligament precede the luxation and sawing of the ends of the bones. If preferred, two lateral incisions may be made.

METACARPOPHALANGEAL JOINT.—Here a single lateral incision is made. The operation is then similar to the preceding one.

HIP.—In civil practice resection of the head of the femur is generally indicated because of tuberculous disease. The joint may be entered in three ways: anteriorly by the straight incision of Barker, laterally through a curved (White) or straight (Langenbeck) incision, and posteriorly through the angular incision of Kocher. In the use of the anterior incision no muscles are divided and the surrounding tissues suffer little damage, but the joint then lies at the bottom of a deep wound which is difficult of drainage. This incision begins about one-half inch below the anterior superior spine of the ilium, and extends downward and slightly inward for three or four inches. By drawing the tensor vaginæ femoris and glutei outward, and the sartorius and rectus inward, the joint is exposed. Branches of the circumflex artery will be met which must be ligated. The joint capsule, cotyloid ligament, and periosteum of the femur are incised in the line of the wound, and when the air enters the joint the articulating surfaces may be parted and the ligamentum teres severed. The periosteum with the attached muscles is separated from the greater tuberosity, and the bone cut with saw or chisel, either above or below the trochanter major, as required. The acetabulum is curetted to remove the diseased area, and if drainage is desired a posterior counteropening is made.

The curved lateral incision of White begins about midway between the anterior superior spine of the ilium and the trochanter and is continued downward around the trochanter or across its outer surface along the outer border of the thigh for a short distance, the knife being carried down to the bone.

Langenbeck's external (or lateral) incision begins at a point three inches above the upper border of the trochanter downward over the trochanter for four or five inches in the long axis of the femur, the patient lying on the sound side with the thigh flexed at an angle of forty-five degrees. After this operation a Buck extension is applied to the leg, which is supported on the sides by sand-bags. The cavity becomes the seat of a fibrous deposit, which allows limited motion.

KNEE.—Resection of the knee may be required for injury, deformity, ankylosis, or most often for disease, and various incisions may be used. A curved incision across the anterior portion of the joint, with convexity downward below the patella, or with convexity upward above the patella, a straight transverse incision passing through the patella, which is sawn, with or without additional short longitudinal lateral in-



Fig. 3.—Resection of the Hip. Anthony White's incision. Commences anteriorly midway between the anterior superior spine of the ilium and the upper border of the trochanter major and curves backward above the trochanter major and then downward behind the trochanter for a distance of about two inches. (McGrath.)

cisions, or, finally, a single longitudinal incision, median or lateral, an incision not suited to cases of disease. Fixation and not motion is desired after resection of this joint.

The usual method is by making an anterior curved incision, from the posterior and upper border of one condyle to the other, the convexity of which reaches nearly to the insertion of the ligamentum

patellæ. The leg is then flexed to a right angle and the tissues divided in the following order: The superficial tissues, ligamentum patellæ, and the anterior lateral, capsular, and crucial ligaments. The popliteal artery and nerve being carefully avoided, the end of the femur is thoroughly exposed and a slice of the required thickness is sawn off, preserving the epiphyseal line if possible, especially



Fig. 4.—Resection of Hip. Langenbeck's incision. (McGrath.)

in children, as the chief growth of the femur is at its lower end; shortening is thus minimized. The saw should be carried in a slightly oblique direction from behind forward, parallel to the epiphyseal line. After removing the articular surface of the tibia in a like manner the diseased soft parts are cut or scraped away. As the patella and the synovial membrane are usually diseased they are removed with the bursæ, and a rubber drainage-tube is placed behind the bones, emerging at each angle of the wound. The bones may be fastened together with catgut, wire, nails, by suturing the ligaments,

or by the application of a fixed dressing. The edges of the incision are then sutured, an antiseptic dressing applied, and the limb immobilized by plaster of Paris or other suitable splint. Immobilization should be maintained for at least two, better for three, months and a posterior splint worn for several months longer, union in the position of nearly full extension being thus secured. The drainage-tubes are usually removed after a few days.

When the joint lesion is extensive and the general health much enfeebled, amputation offers the better chance of life and should be given the preference.

ANKLE.—This joint is seldom resected, as a more useful limb is obtained through the use of an artificial limb than from the ankylosed and fixed ankle-joint resulting from excision. Many methods have, however, been devised for the resection of this joint—lateral, transverse, posterolateral, and posterior, with and without the associated division of tendons and removal of the astragalus.

Langenbeck employs a hook-shaped incision around the lower end of the fibula three inches above the tip, passing along the posterior border, curving around the external malleolus, and then upward on the anterior border for one inch. The flap being lifted, the periosteum and overlying tissues are freed from the bone, which is divided at the upper end of the wound and drawn outward, when the ligaments at the lower end are cut. A second incision, one and one-half inches long, curves around the internal malleolus, and this is joined by a vertical incision two inches long in the median line of the tibia (anchor-shaped). The bone is then freed and removed as on the other side. The astragalus may be removed, wholly or in part, through either opening, the inner being preferred. (See Fig. 5.)

In the transverse method an incision is made across the joint connecting the malleoli. In this method, suture of the anterior tibial nerve and of the tendons complete the operation, and the foot at a right angle with the leg is immobilized in a fenestrated plaster cast.

FOOT.—The tarsal bones may be removed through lateral incisions, or by an incision across the dorsum, suturing the

divided tendons or allowing them to become attached while the wound is healing; suturing is to be preferred. Access to the diseased parts may be obtained by splitting the foot back between third and fourth metatarsals to the midtarsal joint.

An osteoplastic operation (Wladimiroff-Mikulicz operation) has been suggested when there is extensive ulceration or loss of tissue at the heel. It is only in these cases that it has any advantage over an excision. In this operation a flap of the posterior tissues from the level of the malleoli to that of the scaphoid tubercle is removed, the articulating end of the leg-bones and the posterior part of the scaphoid and cuboid are sawn through, the intervening bone excised, the foot placed in extension, the sawn surfaces being apposed, and the wound sutured. The body weight is supported on the ends of the metatarsals, and the under surfaces of the toes bent at a right angle.

IN CONTINUITY OF BONES OF THE LOWER EXTREMITY.—Because of almost certain non-union, the femur should not be the subject of this operation. When done upon the tibia or fibula, however, the prognosis is much better, since regeneration of the bone or compensatory hypertrophy of the untouched shaft frequently insures a successful result. During the period of repair especial care must be taken to prevent deviation of the foot. Operation upon a metatarsal or phalangeal bone of the foot, as also in the hand, may be readily done with prospect of good results; the incision is made over the inner or outer side, rather than the middle, to avoid injuring the extensor tendon.

When a first or second phalanx in the hand cannot be removed subperiosteally, the distal end of the finger should be allowed to drop back. The resulting fibrous union often becomes short and firm, making the finger a useful one, but, if otherwise, amputation is advised.

AMPUTATION.

DEFINITION.—Amputation when applied to the extremity is the removal of the limb in whole or in part in continuity. If performed through a joint it is called a disarticulation. Three varieties are recognized: *primary*, when the operation is

done immediately or soon after the injury; *secondary*, when done after many days, after the subsidence of fever, and *intermediary*, when done during the acute inflammatory stage, usually after two to four weeks or less.



Fig. 5.—Right Leg, Inner Side. *AS*, incision upon the inner aspect of the ankle for resection of the astragalus; *K*, Textor incision for resection of the knee-joint. Dotted lines indicate planes of section through the bones. (McGrath.)

INDICATIONS.—The great war has considerably modified prevailing views in this connection, the old mechanical conception entailing sacrifice of diseased and healthy parts to obtain a perfect stump having been replaced by efforts at plastic or reconstructive surgery. This newer conception, termed **Kineplastic surgery**, is

reviewed on page 825 of the present volume. The subject being comparatively new, however, the older views are also submitted, pending perfect adjustment of the various techniques involved.

As conceived before the newer views, injuries of equal degree involving the upper or lower extremity require different treatment because the collateral circulation is more free in the upper limb. Amputation would be imperative in the lower limb, while conservative treatment or excision would suffice in the upper extremity. In the aged, in alcoholics, in patients with chronic Bright's disease or tuberculosis, and in others with impaired assimilation and elimination, amputation is indicated. The aim is to save life and to provide for suitable artificial supports. *Compound fractures and dislocations* commonly demand amputation, especially where there is much comminution or loss of bone in a lower extremity, since the limb would be useless even if saved; when rupture of the main vessels are also present in a lower limb, amputation is indicated, while if in an upper extremity ligation of these vessels in the wound might permit the limb to be saved. Secondary hemorrhage from the main artery in the lower extremity generally demands amputation, while in the upper limb conservation may be justified.

Amputation is always imperative when there is great laceration or much mangling of the soft tissues, with extensive loss of skin and extensive comminution of bone and lacerated vessels. A limb that will be useless, if saved, usually demands removal. Compound fracture of the knee-joint, by reason of the great damage to the soft parts, often is a reason for amputation; if of the ankle-joint, conservatism may be tried if asepsis can be maintained; at least, if the soft parts are not much damaged excision may be done. The same rule applies to the shoulder and elbow, but a serious compound fracture of the wrist calls for amputation.

Compound dislocations of the shoulder, elbow, hip, and ankle are best treated by excision so long as the soft parts are only slightly injured, but in compound dislocations of the knee the popliteal vessels and the collateral circulation are so frequently damaged that amputation is safest.

Avulsion of an extremity in whole or in part demands amputation at a higher point, or when the entire limb is gone flaps must be made of the remaining portions of the soft parts, coapted as nearly as possible.

Lacerated and contused wounds with extensive comminution of bone (as in gunshot wounds) often demand amputation. Lacerated and wounded arteries are rarely an imperative demand for amputation except in the case of traumatic or diffuse popliteal aneurism, or that of the deep arteries of the leg, or for traumatic axillary aneurism; it is often indicated in secondary hemorrhage from a traumatized vessel or an artery ligated in continuity.

Gangrene from frost-bite, burns, traumatism, or from wounds of an artery, or its gradual occlusion in children, calls for amputation far above the diseased area; in senile gangrene, even, amputation of the leg or thigh is sometimes preferred.

Destructive diseases of the bones and joints, where the soft tissues are extensively involved, strongly indicate amputation.

Malignant tumors of the limbs, when they have invaded the bones or other important structures, so that they cannot be safely removed, demand amputation, the whole infected bone being taken away and the amputation being done at or above the joint on the proximal side of the disease.

Deformities, as severe club-foot, limbs that are useless through cicatricial bands, faulty union of fractures, etc., sometimes require amputation in young, healthy patients, usually to prepare the limb for a suitable appliance (artificial leg, etc.).

In injuries three points must be considered when treatment is contemplated: Is the blood-supply sufficient to prevent gangrene? Is the injury to the nerves and soft tissues so extensive that a useful limb cannot be obtained? Is it possible to prevent or control infection?

Primary amputation may be indicated after a bite from a venomous snake or after infection with very virulent organisms. Secondary amputation is often required for secondary hemorrhage, chronic sepsis, osteomyelitis, exhaustion or amyloid disease, or to remove a useless limb.

PRELIMINARY CONTROL OF HEMORRHAGE.—This is secured by applying an Esmarch band or other tourni-

quet, after the blood has been allowed to drain back into the circulation by elevating the extremity for several minutes. At the hip and shoulders the band may be prevented from slipping downward by long pins thrust through the tissues below the band, as suggested by Wyeth, by sutures encircling the band, or by a bandage placed beneath the band and around the trunk. Digital pressure may be used to occlude the main vessels where the elastic band is not advisable or applicable (atheroma, interscapulothoracic amputation, etc.), or the main vessels may be exposed by a preliminary incision and secured by clamp or ligature.

INSTRUMENTS.—These are a tourniquet (Petit's) or Esmarch's apparatus to arrest hemorrhage during the operation, knives, saws, cutting bone forceps, retractors, lion-jaw forceps (Ferguson's) to hold bone fragments, tenacula, artery and hemostatic forceps to secure the vessels, needles, sutures, scissors, and dressing forceps, and Halstead's "gut wool" or Horsley's "antiseptic bone wax" (beeswax, 7; almond oil, 1; salicylic acid, 1) for controlling undue hemorrhage from the bone, and retractors (two- or three-tailed aseptic bandage); after operation: drainage material (gauze, rubber tubing, or cigarette drains), antiseptic dressings, a splint to fix the joint above the amputation, bandages, etc.

METHODS.—These are numerous, but all are modifications of the *circular method*, in which the skin and superficial fascia are divided by a circular cut around the limb, and are dissected up so as to form a cuff, the muscles cut down to the bone, and the bone sawn higher up; and of the "*flap method*," in which the bones are covered by variously shaped "flaps" of skin, fascia, and muscle. In both methods sufficient periosteum should be provided to cover the bone, muscular tissue to cover the periosteum, and skin to fully cover the muscle. The line of union which forms the subsequent scar tissue should be so arranged that the scar shall not be subjected to pressure. The flaps should not fit too closely, as the tissues contract considerably after operation, but should be somewhat ample.

THE CIRCULAR AMPUTATION.—By a circular sweep of the knife the skin and the subcutaneous tissues are divided around the whole circumference of the limb

and dissected back like a cuff. The superficial and then the deep muscles are divided in like manner at a higher level, so that the upper cut surfaces resemble a hollow cone. The periosteum is then divided and reflected in a similar manner, and after retracting the soft parts with a wide two-tailed muslin bandage the bone is sawn high up, next to the cuff of periosteum, and the latter is drawn down over it after arresting all hemorrhage from the bone. The skin incision should be at least two-thirds of the diameter of the limb (at the point of sawing the bone) below the level of the plane in which the bone is divided. The circular amputation is seldom used except for the arm, as the stump usually becomes conical and the scar is opposite the end of the bone. The *oval amputation* (Kocher) is a modification of the circular, in which an oblique or elliptical incision is made around the limb, the distal portion is dissected up, a circular division of the muscles being made slightly below the proximal part of the incision, and the free convex border is sutured to the concave portion. In the *racquet amputation* (Kocher), another modification, a straight incision is made in the axis of the limb (handle of the racquet) and a circular or oval incision is made around the limb (rim of the racquet). A short flap of skin and subcutaneous tissues is made; the muscles are divided obliquely.

THE FLAP AMPUTATION.—The flaps in the amputation may be either *lateral* or *anteroposterior* and *single* or *double*, and are used in operations through the shafts of long bones. The flaps may consist of skin alone, or of muscle and skin. When the muscle is included there must be enough skin to cover the muscle, enough muscle to cover the bone, and the bone must be sawn above the angle of junction of the flaps. The flaps should be half the circumference of the limb in width, and the aggregate length of both flaps should be at least five-eighths of the circumference of the limb at the point where the bone is divided. Though the incision is made more rapidly by transfixion, there is apt to be a redundancy of muscle; a better stump can be made by cutting from the skin inward, or one flap may be made in that manner and the other by transfixion. Musculocutaneous flaps are desirable, for by using buried ani-

mal sutures all cavities may be obliterated, and all drainage, except capillary, can be omitted, which is impossible when cutaneous flaps are made.

MIXED METHOD OF AMPUTATION.—In this method two semilunar, or rectangular (with rounded corners) flaps are made on opposite sides of the limb. These flaps of skin, subcutaneous tissue, and fascia are turned back and the muscles divided circularly at the level at which the bone is sawn. The best is where the semilunar flaps are made as suggested by Syme.

PERMANENT CONTROL OF HEMORRHAGE.—Before removing the tourniquet or Esmarch's band, the large vessels are picked up with hemostatic forceps and ligated with chromicized gut or silk. As the tourniquet is being loosened, the smaller vessels are seized with hemostats and ligated. Pressure with antiseptic gauze or very hot water will control the capillary oozing. Nerves and tendons should be drawn out and cut short, and with rongeur forceps any sharp or projecting spiculæ of bone are removed. Hemorrhage from the bone may be arrested by using Horsley's bone wax.

DRAINAGE AND CLOSURE OF WOUND.—Drain the oozing surfaces with gauze (strips or cigarette) or rubber tubing emerging at the lowest part of the wound. The flaps of periosteum and muscle are sutured over the ends of the bones with catgut and the skin flaps secured with silk-worm gut. An antiseptic dressing is applied and the stump, firmly bandaged, is placed on a pillow or in a splint. The drain may be removed and dispensed with in forty-eight hours if there is no infection present.

THE STUMP.—When healed the stump should be round, freely movable and without pain, even on deep pressure. The scar should not adhere to the bone and should lie without the pressure area. The stump tissues atrophy. The end of the bone becomes smooth and its medullary cavity becomes covered in with bony tissue. Necrosis of the end of the bone may follow, if it has been deprived of its periosteum, especially if followed by infection. *Sloughing of the flaps* may occur when the amputation is done too close to the diseased area, from too thin flaps, when the patient is constitutionally debilitated from diabetes, or

when the flaps are too thin, or where atheroma is present and, when extensive, may require reamputation. *Neuralgia of the stump* occurs when a nerve becomes imbedded in the scar tissue, or from the formation of a neuroma; excision will remove either cause, or the nerve may be cut off higher up or reamputation may be required. Senn advised the removal of the bulbous end of the nerve by a V-shaped incision and suture of the nerve-flaps to prevent recurrence. *Spasmodic* stump may complicate neuralgia of the stump, and is cured by the same means. Relief is not obtained, however, when it has a central origin. *Conical stump* may be due to too short flaps, cicatricial contraction following infection, and, in children to a continued growth of bone; the end of the bone may protrude in aggravated cases. Reamputation here is necessary. *Ulceration of the scar* may be due to thinness of scar, especially when adherent or submitted to pressure; it may, however, be caused by constitutional disease (syphilis). When extensive the only relief is from reamputation. *Epithelioma* of the scar tissue is not rare.

SPECIAL AMPUTATIONS.

AMPUTATION THROUGH A PHALANX.—This may be done either by two semilunar flaps or by a single palmar flap. It must be borne in mind that the joint in the last row of phalanges is one-twelfth of an inch below the most prominent part of the knuckles; in the middle row, it is one-sixth of an inch below, and at the metacarpophalangeal joint one-third of an inch below. A narrow, sharp-pointed bistoury is used, and the flaps are cut from within outward. The lateral ligaments are divided and the knife-edge, entered on the dorsal aspect of the joint, is passed between the bone and carried downward and forward, severing the palmar ligaments and completing the disarticulation.

AMPUTATION AT THE METACARPOPHALANGEAL JOINTS.—Double lateral flaps may be used, or the patient's hand being pronated a longitudinal half-inch cut is made over the head of the metacarpal bone, the incision being then carried obliquely down on one side to the interdigital web across the base of the phalanx and upward to meet the longitudinal

incision, dividing the tissues down to the bone. The tendons and lateral ligaments are then divided and the disarticulation completed. All the fingers may in this manner be separately removed; or by a transverse dorsal incision we may effect disarticulation, a palmar flap being made from within outward.

AMPUTATION OF THE THUMB AND LITTLE FINGER.—The modified oval method advised for the disarticulation of the entire fingers is well suited for amputation of the little finger and amputation of the thumb through its metacarpal bone, or with this bone.

AMPUTATION OF THE METACARPUS.—When a portion or all of the metacarpus, either alone or with a portion of the carpus, is to be removed the formation of the flaps must be governed by the condition of the tissues.

AMPUTATION AT THE WRIST.—This may be made by an elliptical incision, one-half inch below the articulation on the dorsal side and two inches lower on the palmar side, passing between the pisiform and the base of the metacarpal on the ulnar and crossing the carpometacarpal joint on the radial side, opening the joint from the dorsal surface. In Dubreuil's method an external lateral flap is made by an incision

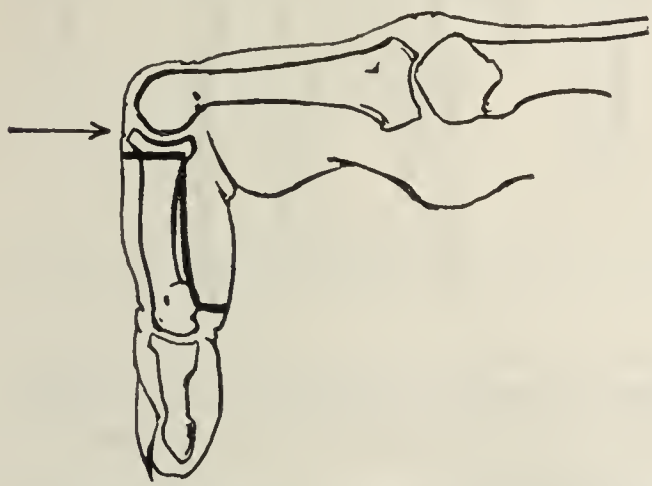


Fig. 6.—Exarticulation of the Finger at the Phalango-phalangeal Joint. The arrow indicates level of the joint when the finger is flexed. Heavy line indicates the long anterior flap. (McGrath.)

beginning at the junction of the middle and outer thirds of the dorsal surface of the wrist, curving downward to the head of the metacarpal bone of the thumb, and then passing upward upon the palmar surface to a point opposite the starting point. It is well to include in the flap some of the

muscular tissue of the thenar eminence. A circular incision on the ulnar side connects the ends of the flap. The wrist is then disarticulated. If desired, a long palmar flap reaching to the middle of the metacarpal bones may be used.

The circular method is preferred by many, the circulation being controlled through the



Fig. 7.—Exarticulation of the Finger. A, incision for exarticulation at the metacarpophalangeal joint; B, incision for amputation of finger with excision of the head of the metacarpal bone; C indicates long anterior flap in exarticulation through the phalango-phalangeal joint. (McGrath.)

brachial artery. The incision is made from one to one and one-half inches below the radiocarpal joint, the flap reflected, and the joint opened from the radial side. After disarticulating the joint, the vessels (three or four) are secured.

AMPUTATION OF THE FOREARM.

—Here any of the flap methods may be used. The muscles are divided by a circular cut, the interosseous membrane severed, a three-tailed muslin retractor applied and both bones sawn at the same time, after making a slight groove in the radius as a guide. The circular method is sometimes used, but the anteroposterior musculocutaneous flaps are preferred, being cut from without inward. The tendons, in Vanghetti's operation—also known as cinematic amputation—are cut longer than the bones, and by suturing the ends together or by turning the tendons back upon themselves loops are formed, or knobs are made by tying the ends in knots or by chiseling off the bony insertion. These loops or knobs are im-

bedded in the skin flaps, so that when healed they may be attached to hooks or strings for the purpose of transmitting movement to an artificial limb.

AMPUTATION AT THE ELBOW.

—The results of this operation are unsatisfactory, amputation either above or below the joint being preferred. The elliptical or

or by cutting from without inward. The anterior flap should be the longer, as the biceps contracts more than the triceps, and the bone must be carefully cleaned behind. The brachial and superior profunda arteries and several smaller vessels require ligature.

Single or double flaps can be made if the location of the disease or injury prevents the use of the anteroposterior flaps.

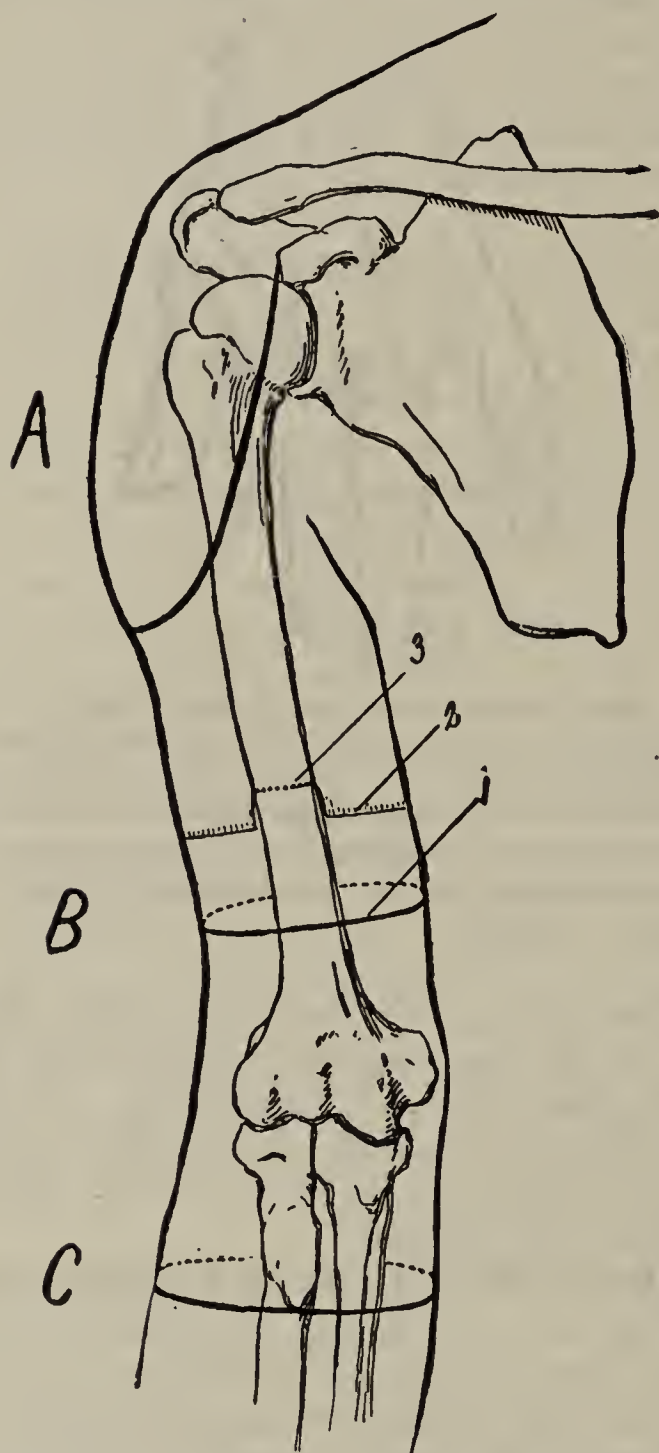


Fig. 8.—Right Arm, Anterior Aspect. *A*, outline of the lateral deltoid flap in exarticulation at the shoulder-joint; *B*, amputation through the arm; 1, incision through the skin; 2, incision through the muscle; 3, line of division through the bone; *C*, incision for exarticulation through the elbow-joint (circular method). (*McGrath.*)

long anterior flap methods or the flap method of Guérin may be used.

AMPUTATION OF THE ARM.—

While the circular method does well here, the anteroposterior flap method is better. The flaps are made either by transfixion

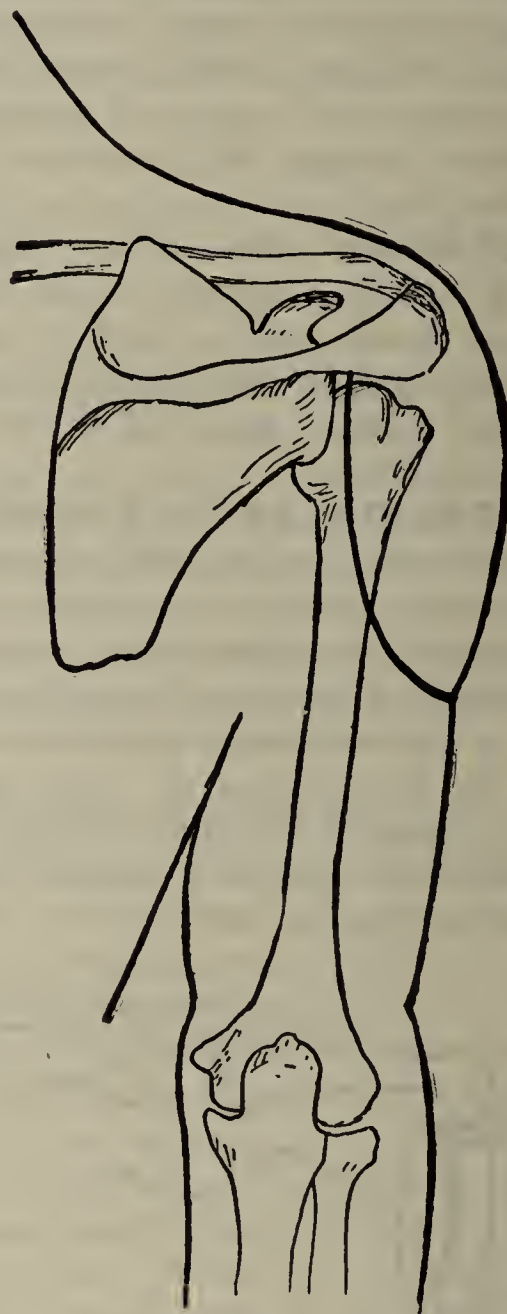


Fig. 9.—Right Shoulder, Posterior View. Outline of the lateral deltoid flap for exarticulation at the shoulder-joint. (*McGrath.*)

AMPUTATION AT THE SHOULDER.—

The classical operations are those of Larrey, Dupuytren, and Spence.

In the oval or Larrey's method the circulation is controlled by compressing the subclavian artery against the first rib. The point of a medium-sized knife is entered below and just anterior to the top of the acromion, making a six-inch longitudinal cut down the outer side of the arm. The oval incision begins at the center of the longitudinal cut and is carried obliquely around the

arm. The flaps are reflected from the outer aspect of the joint, and the extremity removed.

In Dupuytren's method there is a U-shaped flap extending from the coracoid process to the root of the acromion, the lowest point being at the insertion of the deltoid. The inner flap is formed by an incision joining the ends of the former and extending two inches below the axilla. Disarticulation is done as in the other methods.

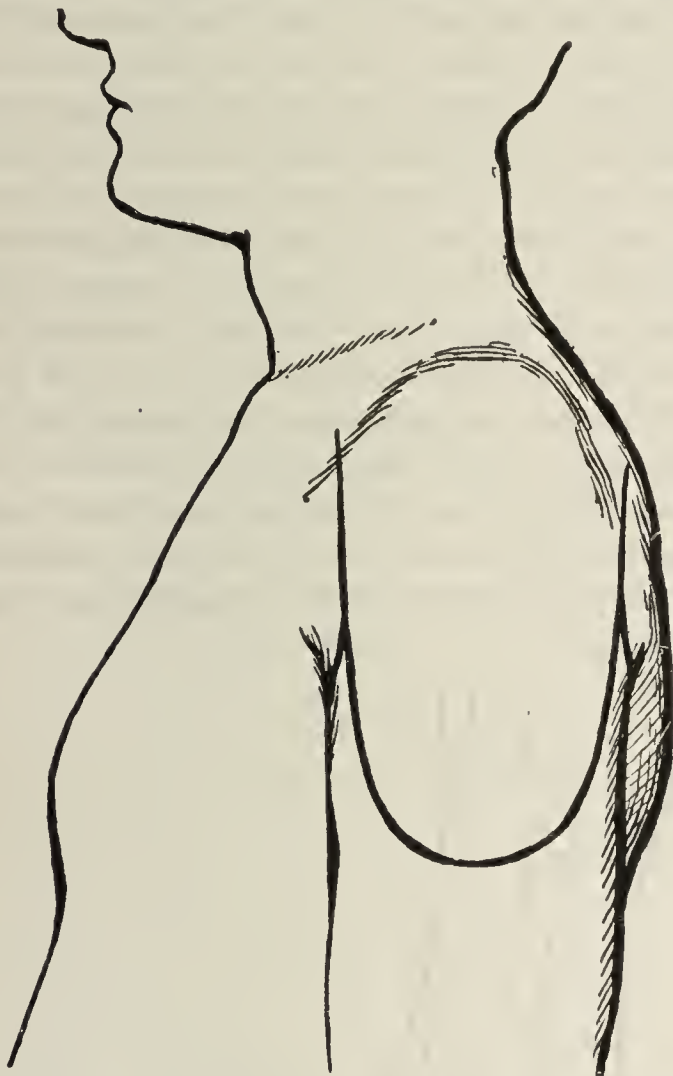


Fig. 10.—Left Shoulder, Side View. Outline of the lateral deltoid flap for exarticulation at the shoulder-joint. (McGrath.)

In Spence's method an incision down to the bone is made from midway between the coracoid and acromion, downward and outward for three or four inches. The joint may be opened at once for examination if desired. The incision is then carried downward and inward across the axillary fold and around the arm to the end of the first incision. After reflecting the skin for an inch or more, the muscles on the inner aspect are divided obliquely, exposing the axillary vessels, which are ligated and divided. The soft parts on the outer side are detached from the bone, the inner half of the capsule and the subscapularis divided, the head of

the humerus drawn outward, the division of the capsule completed, and the remaining tissues freed by carrying the knife downward close to the inner side of the bone, to avoid injuring the posterior trunk of the circumflex artery.

INTERSCAPULOTHORACIC AMPUTATION.—In this amputation we remove the entire upper extremity, arm, scapula, and the whole or a part of the

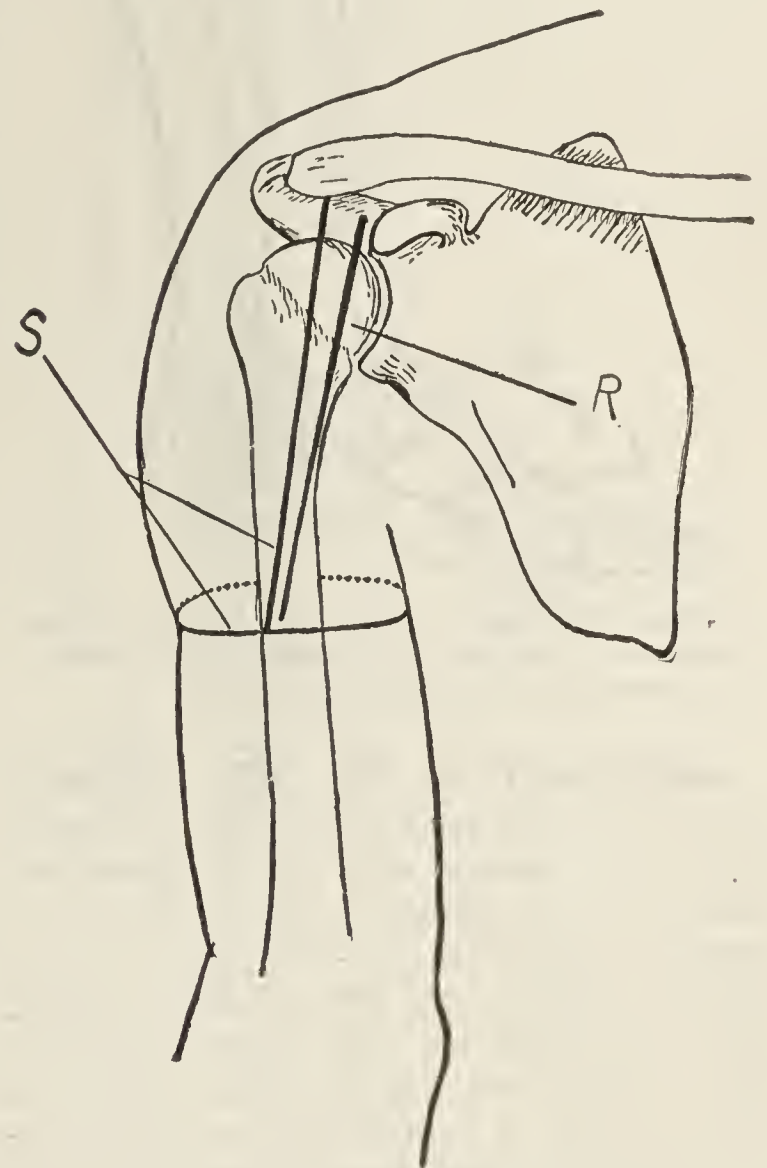


Fig. 11.—Right Shoulder, Anterior View. *R*, line of incision for resection of shoulder-joint; *S*, incision for exarticulation at the shoulder-joint. (Spence.)

clavicle. Preliminary control of hemorrhage is secured by ligating the subclavian vessels through an incision made along the clavicle after resection of the middle third of the clavicle (Berger's method), or after disarticulation of its sternal end (Le Conte's method), puncture of the pleura being carefully avoided. The anterior flap is formed by making an incision from the center of the clavicular incision downward and outward across the axillary fold and backward to the lower angle of the scapula. The muscles are divided, and the exposed brachial

nerves are cut on the same level as the subclavian vessels. The arm is then carried across the chest, and by joining the ends of the two previous incisions a posterior flap is formed. After detaching the scapular muscles the whole limb is removed.

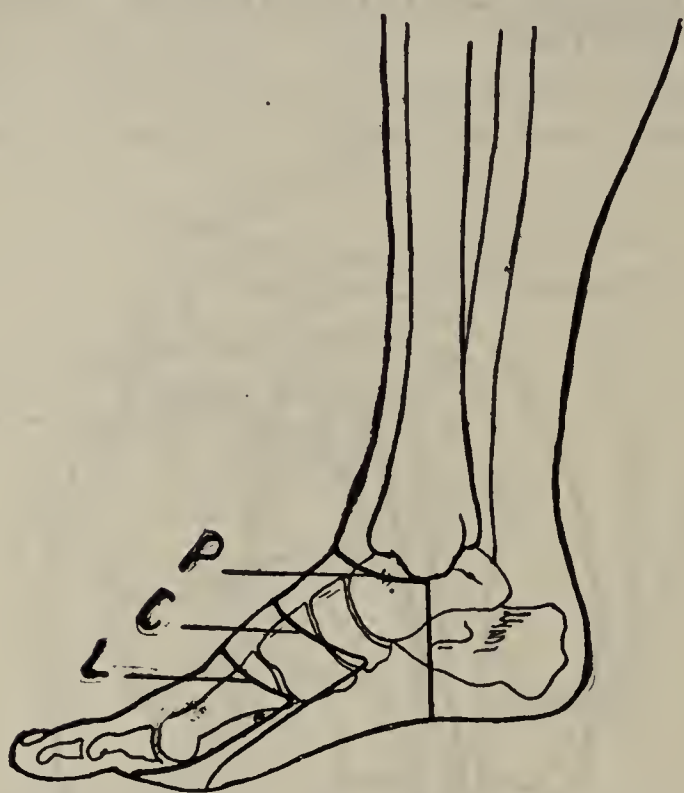


Fig. 12.—Right Foot, Inner Side. C, incision for Chopart; L, incision for Lisfranc; P, incision for Pirogoff. (McGrath.)

AMPUTATION OF THE TOES.—

With the exception of the great toe amputations are always made at the metatarso-phalangeal articulation. This operation is identical with that for the fingers except that the joint is the same distance behind, as the tip of the toe is in front of the web. The oval method may be used. When *all the toes* are to be removed the joints are opened by a dorsal incision with convexity downward, dividing the tendons, disarticulating, and making a plantar flap by passing the knife, on the flat, behind the bones. In removing the *great toe* by the oval method, the preliminary longitudinal incision is made to curve somewhat upward over the base of the metatarsal bone to give more room. The same method may be used in removing two or more toes with their metatarsals, the incision starting one-half inch above the tarsometatarsal joints, and directing it so as to include the toes to be removed.

AMPUTATION THROUGH THE METATARSUS.—A short dorsal flap, slightly convex downward, is cut from within outward, and a long plantar one. These are freed and the bones sawn across.

The line of union will be on the dorsum of the foot.

AMPUTATION THROUGH THE TARSONOMETATARSAL JOINTS.—

In *Lisfranc's operation* a curved incision, convex downward, is made, running from the base of the first metatarsal across the dorsum of the foot to the base of the fifth. A long plantar flap is made, including all the tissues to the bone. Reflect the flap slightly and disarticulate first the outer three metatarsals, then the first, and finally the second by cutting upward between its base and the internal cuneiform for about half an inch; the same is done on the outer side and the separation is completed by a transverse cut, severing all the ligaments between the middle cuneiform and the base of the metatarsal bone. In *Hey's operation* the outer four metatarsals are disarticulated, and the internal cuneiform bone is sawn off in a line with the other metatarsal articulation. In *Bauden's method* the first metatarsal is disarticulated and the remaining ones sawn through at the same level. In *Skey's method* the base of the second metatarsal is sawn through.



Fig. 13.—Right Foot, Outer Side. C, incision for Chopart; L, incision for Lisfranc; P, incision for Pirogoff. (McGrath.)

AMPUTATION AT THE MEDIO-TARSAL JOINT.—

In *Chopart's operation* a dorsal incision is made from the inner side of the tuberosity of the scaphoid, which curves forward to within an inch of the ends of the metatarsal bones, to the outer side at a point midway between the outer malleolus and the base of the fifth

metatarsal. Forcibly depress the anterior portion of the foot, and disarticulate by severing the ligaments. The knife is then slipped behind and under the bones, and a large plantar flap is formed somewhat longer on the inner side.

SUBASTRAGALOID OPERATION.

—The stump in this operation, covered by the skin of the heel, is a useful one. The incision is racquet-shaped, starting at the insertion of the tendo Achillis, and passing along the outer side of the foot to a point just above the base of the fifth metatarsal, when it is continued around the foot. After reflecting the dorsal flap the tendo Achillis is severed, the astragaloscaphoid joint opened, the foot twisted inward, and the astragalus removed from the os calcis. The latter is then cleared and the foot removed.

AMPUTATIONS AT THE ANKLE-JOINT.—In Syme's amputation the ankle-joint is disarticulated and the articular surface of the tibia and the malleoli are removed. The incision, made down to the bone, begins at the top of the external malleolus, and passes down under the heel to a point one-half inch below and behind the internal malleolus. The tissues of the sole back of the os calcis are dissected off, hugging the bone closely, until the point of the heel is passed; the tendo Achillis is then severed. The ends of the first incision are united by a transverse incision across the instep, the joint is opened, the lateral ligaments divided, and the disarticulation completed. Finally the ends of the tibia and fibula are cleared, the malleoli sawn off with a small section of the articular surface of the tibia.

In *Pirogoff's amputation* the posterior portion of the os calcis is sawn off and applied to the sawn ends of the tibia and fibula. The plantar incision, forming a right angle with the dorsal, is carried obliquely forward instead of vertically downward. The lower ends of the tibia and fibula are sawn obliquely and nearly parallel with the sawn surface of the os calcis. The bones are then wired together or held in place by catgut sutures, including the periosteum. The limb is then secured on a posterior splint. *Le Fort's modification* consists in sawing the tibia and os calcis horizontally, while in *Ferguson's method* the malleoli are

allowed to remain and the fragment of the os calcis is adjusted between them. (See Figs. 12 and 13.)

AMPUTATION OF THE LEG.—The choice of method will depend largely upon the level at which amputation is made. In

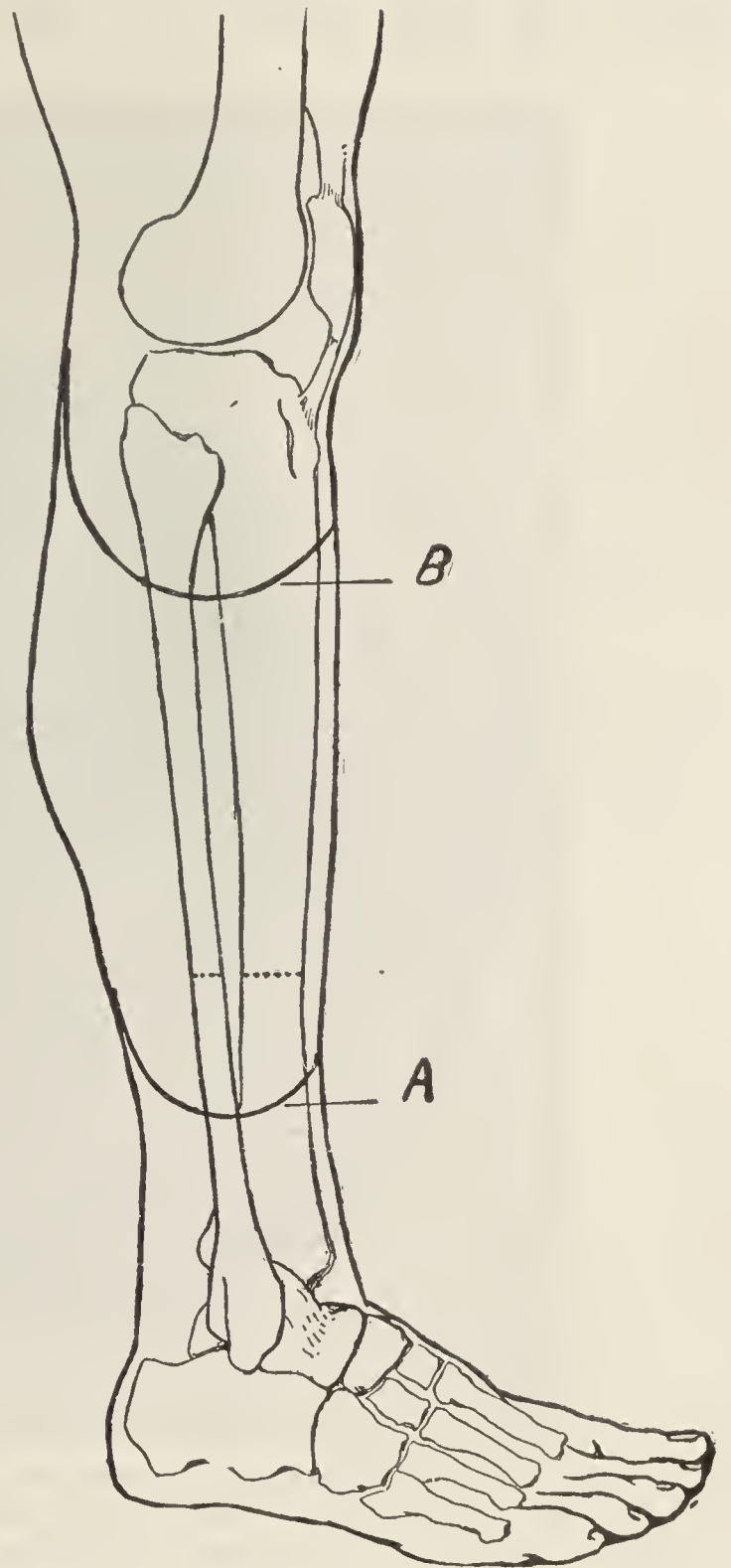


Fig. 14.—Right Leg, Outer Side. A, outline of hooded skin flap in amputation of the leg. Dotted line shows line of division through bones. B, outline of the skin flap in Stephen Smith hooded flap for exarticulation at the knee-joint. (McGrath.)

the *lower third* the modified circular may be used, although lateral flaps of equal length are preferred by many. Osteoplastic flaps as suggested by Moschowitz may be fashioned from the malleoli to cover the ends of the tibia and fibula, care being exercised

that they are on the same plane as the articular cartilage of the tibia.

In *Teal's operation* two rectangular flaps, including all the tissues down to the bone, are made. The long anterior flap should be equal in length and breadth to one-half the circumference of the leg at the site of amputation; the short posterior flap, which

tion is vertical, a dependent angle allowing adequate drainage.

In all leg amputations a better stump will be obtained by removing one-half inch more of the fibula than of the tibia. The sharp tibial crest should be beveled by sawing the tibia for an inch obliquely from above downward and backward, and then by a



Fig. 15.—Section through the Middle of the Right Leg. A.A.V., anterior tibial artery and vein; G.E., gastrocnemius externus; G.I., gastrocnemius internus; P.B., peroneus brevis; P.L., peroneus longus; P.V., peroneal artery and vein; P.V.N., posterior tibial artery and nerve. (McGrath.)

contains the larger blood-vessels, should be one-quarter the length of the anterior long flap.

In the middle and upper thirds two lateral flaps of equal length may be satisfactorily used, but *Sédillot's method* is to be preferred, in which the external flap is long and the internal short. The anterior and posterior tibial and peroneal arteries, with two or three smaller branches, will require ligature. The line of union in this opera-

tion is vertical, a dependent angle allowing adequate drainage.

AMPUTATION AT THE KNEE-JOINT.—This may be made by using bilateral flaps, the inner one longer (*Stephen Smith's method*); or a long anterior quadrilateral cutaneous flap with rounded corners, the incision being made from one condyle to the other, extending to a point five inches

below the patella) and a short, curved incision uniting the ends of the former. The patella may or may not be removed.

AMPUTATION ABOVE THE KNEE.

—This amputation, also called supracondyloid amputation of the femur, is made, by *Carden's method*, by dissecting up a large, rounded, anterior, cutaneous flap, dividing the tissues behind by a transverse cut and severing the muscles in a similar manner down to the femur in front above the patella, which, by flexing the knee, is drawn downward. The operation is completed by

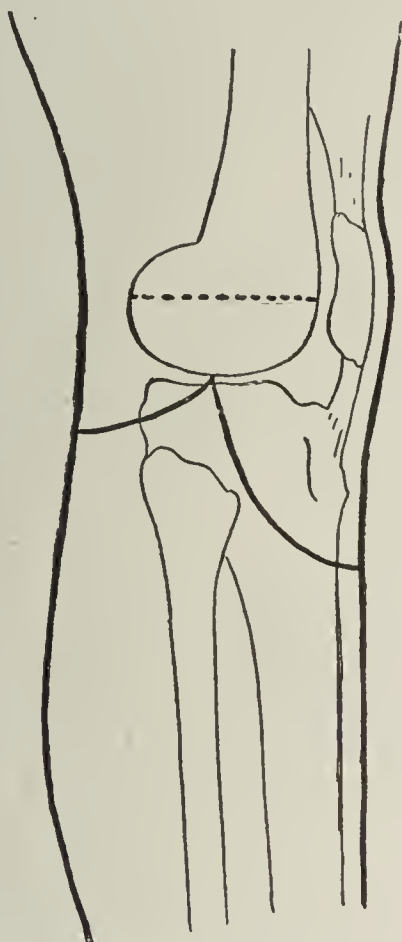


Fig. 16.—Right Leg. Carden's Amputation. Solid line indicates flaps. Dotted line shows line of division through the condyle. (McGrath.)

sawing through the base of the condyles just below the epiphyseal line.

In *Gritti's osteoplastic method* the anterior semilunar flap extends from the condyles of the femur to the tibial tubercles and includes the quadriceps extensor tendon and the patella; the posterior flap is made by an incision connecting the ends of the anterior. The femur is sawn across above the condyles, the cartilaginous surface of the patella is then removed with a fine saw, and the two freshened osseous surfaces maintained in apposition by sutures of wire or catgut.

Sabanejeff uses a bone flap from the tibia to cover the end of the femur.

AMPUTATION OF THE THIGH.—

Any of the usual methods may be used. The flap and modified circular methods are perhaps best. In high amputations where the tourniquet or Esmarch band cannot be



Fig. 17.—Stump After Carden's Amputation. (McGrath.)

used, Wyeth's pin method or digital compression of the femoral against the pelvic brim may be necessary.

Amputation through the trochanters is less dangerous than exarticulation of the hip, and may be done for injury or malignant disease; in the latter case, if the bone is found to be

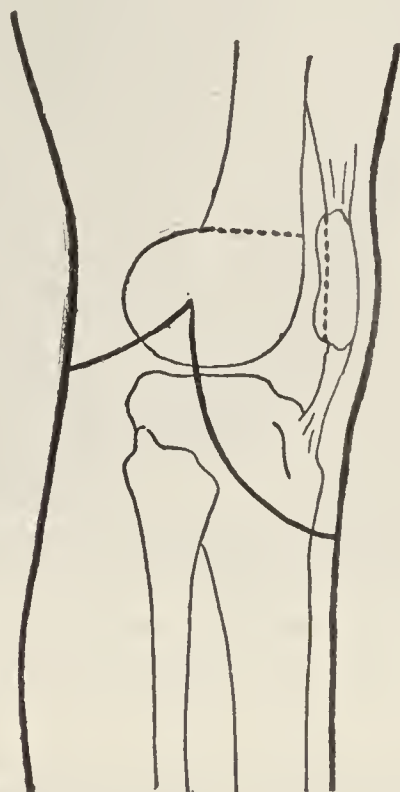


Fig. 18.—Gritti-Stokes Amputation. Solid lines indicate flaps. Dotted lines show section through femur and patella. (McGrath.)

diseased, the remaining fragment may be dissected from the joint.

AMPUTATION AT THE HIP-JOINT.

—In this operation there are unusual dangers from hemorrhage, shock and sepsis. To diminish shock the patient's body and the

other three limbs may be encased in cotton secured by bandages. To control hemorrhage the femoral vessels may be exposed and ligated, the smaller vessels being secured by hemostatic forceps as they are divided; this is perhaps the best method. Pressure upon the aorta by various forms of tourniquets and pressure upon the ex-

"One pin is inserted one-fourth of an inch below and within the anterior superior spine of the ilium, and, after traversing the muscles and fascia on the outer side of the hip, emerges on a level with the point of entrance. The point of the second pin is thrust through the skin and tendon of the origin of the adductor longus muscle, one-



Fig. 19.—Section through the Middle of the Right Thigh. A.V., femoral artery and vein; G., gracilis muscle; R., rectus muscle; S.N., sciatic nerve. (McGrath.)

ternal iliac vessels with Davy's rectal lever are both dangerous. Direct digital pressure on these vessels, as suggested by McBurney, is safe but tiresome. Pressure by a rubber tourniquet secured to the pelvic brim by two long steel pins (Wyeth's), by sutures or by a loop passing around the abdomen is safe, the Wyeth method being most used.

Wyeth's Bloodless Method.—The limb is first exsanguinated by applying a rubber bandage from the toes up to the trunk.

half inch below the crotch, the point emerging one inch below the tuber ischii. The points should be shielded at once with corks to prevent injury to hands of the operator. No vessels are endangered by these skewers. A piece of strong white-rubber tubing one-half inch in diameter when unstretched, and long enough when in position to go five or six times around the thigh, is now wound tightly around above the fixation needles." The Esmarch bandage is then re-

moved. An external racquet incision is used, the external portion of which extends downward for six inches from the rubber band, and is then completed by a circular incision around the thigh. The skin and subcutaneous tissues are reflected to the lesser trochanter and the muscles severed at this level. The capsule of the joint is opened and the head of the bone forced from

are divided by the circular sweep through the muscles. If the artery is not to be ligated after the skin flap has been reflected, the abdominal tourniquet, digital pressure or other means for controlling the hemorrhage must be used. Liston advised an anteroposterior flap method. *Larrey's operation* is the lateral flap method, useful when the injury or tumor for which opera-



Fig. 20.—Exarticulation at Hip-joint. Wyeth pins in place to prevent ligature from slipping. Upon the outer side of thigh the incision reaches to the bone. A circular flap has been turned back and the muscles and blood-vessels divided down to the bone. Clamps applied to femoral artery and vein. (McGrath.)

the socket by carrying the thigh upward, inward and forward. The round ligament is cut and the limb removed.

The *modified circular operation* is useful when a tumor involves the muscles high up. Short anteroposterior skin flaps are used, a circular cut of the muscles being made at the joint level, and disarticulation performed. After the flaps have been reflected the femoral vessels can be tied, before they

tion is required necessitates lateral flaps. *Esmarch* divides the femur at the level of the circular incision, ligates all the blood-vessels, removes the constrictor, and then enucleates the upper end of the bone.

The *anterior racquet operation* without the use of a constrictor is perhaps the best method (Stewart). In this a longitudinal incision three inches long is made from the middle of Poupart's ligament downward.

The common femoral vessels are divided between ligatures, and the incision is continued downward and inward across the inner side of the thigh about four inches below the crotch, and thence around the thigh to meet the first part of the incision. After separating the outer flap, which includes the muscles, from the femur, the bleeding vessels are ligated as they are discovered. Rotating the limb outward, the process is repeated on the inner side. After opening the capsule the head of the bone is disarticulated forward, the round ligament divided, and the tissues on the posterior surface severed by cutting downward and outward behind the bone.

INTERILIOABDOMINAL AMPUTATION.—In this operation the entire lower extremity, including the whole or a part of the innominate bone, is removed. Ransohoff performed this operation thirty-four times, with ten recoveries.

SUMMARY OF WAR AMPUTATIONS.—A study of the functional status of amputations during the most violent activities of the war, and based on nearly 2500 operations by himself and others was prepared by Tuffier for the Paris Academy of Medicine (Surg., Gynec. and Obstet., Aug., 1916). It demonstrated that a considerable percentage had to be operated 2 or more times, and that after amputation a mutilated soldier had 30 out of 100 chances of having to submit to a new operation. The **reamputations** usually involved the lower extremity, being generally called for because of the classical circular incision. The lesions which rendered an amputation stump unfit for an artificial limb were, in order of frequency: incomplete cicatrization by ulceration or fistula; pains, spontaneous or provoked by the apparatus pressure; often these causes combined. The ulcerations were often caused by too short or scant flaps or diseased bone or nerves and lack of post-operative care. All urgent amputations being as a rule, infected, periosteal denudation should be carefully avoided, being unnecessary and dangerous.

Caries and necrosis were common reasons for reamputation.

The practical conclusions drawn by Tuffier for each variety of amputation are as follows:—

A **hip amputation** should be made as low as possible, leverage being of cardinal importance, especially in the upper third of the femur. A stump of 10 cm. is the minimum required for the prosthetic apparatus. A femur 14 to 15 cm. long is necessary.

A **sub- or intra- trochanteric amputation**, or of the upper fourth of the femur, is hard to fit with apparatus and the amputated walk on the pelvis. It should, however, not be abandoned. To diminish the inconvenience the femur should be straightened as much as possible during the healing of the wound.

Circular amputations give cicatrices which have all defects: seat, form, and adherence, and afford deplorable results. A number of such stumps cannot be fitted with artificial limbs, and they require 1 or 2 reamputations. Although a posterior flap may leave a stump a little too large it can be reduced by compression. An anterior flap or a combination of 2 flaps should be preferred; an external flap gives acceptable cicatrices.

Leg amputations immediately below the articulation give good general results. All leg amputations should give a cicatrix that will allow for a point of support on the stump directly or on the tibial notches, and should be performed as low as possible.

As shown by radiographs, the fibula is cut much too low, far below the tibia. High sectioning of the fibula is advisable. When the amputation is to be done less than 8 cm. from the knee, it is best to cut the bones higher than lower. Very high cutting, even in the tuberosity of the tibia, gives excellent results. In all such amputations it is advisable to provide for the perfect mobility of the knee, and to direct the cicatrization of the soft parts by elastic molds or by traction.

Tibiotarsal disarticulation, with the cutting of the malleoli as well as the **intra-malleolar amputation**, gives good results. **Subastragalus amputation** gives good results. **Subastragalus disarticulation**, the **osteoplastic amputation of the calcaneus**, and the **Syme operation** are recommended. They all permit the ready fitting of artificial appliances which the stump bears without trouble.

Military experience has shown that in war surgery, suppuration being the rule, the Chopart operation is to be discarded; to improve results from this procedure one has to perform two astragalectomies with calcaneal osteoplasty. In many so-called Chopart operations the scaphoid has been forgotten. Lisfranc's and similar amputations give good stumps on which the patient, with an orthopedic shoe, can walk easily and even gracefully. A number of amputations of this type were done for frozen feet. The writer recommends subastragaloid disarticulation, osteoplastic amputation of the os calcis, and the Syme operation; the fitting with apparatus is easy and the stump tolerant. Though a thigh amputation in the upper fourth of the femur is harder to fit with an apparatus than a disarticulation of the hip-joint, and yields no better functional results, it is of value in that the immediate operative danger is less. The femur should be straightened as much as possible during healing of the wound. For good motion at the hip-joint the femur in thigh amputation must be left 14 to 15 cm. long; to permit the use of the apparatus at all, it must be at least 10 cm. long. Circular thigh amputation is faulty; an anterior flap or combination of two flaps is the method of choice, and should therefore be employed unless the lower bone section feasible in the circular method renders the latter advisable in the individual case. The process of scar formation should be carefully directed by means calculated to approximate and exert traction upon the flaps. The sciatic nerve must be cut high up. Intracondylar amputations give good ambulatory results. Tuffier (*Arch. de méd. et de pharm. milit.*, 1916).

The writer warns against hasty amputation in gunshot injuries of the foot, even when severe. Any amputation performed should be done through healthy tissues. To be sure, if the operation is done early, union by first intention and rapid return of

functions of the foot may be obtained, even in articular wounds. If there is joint suppuration amputation may be necessitated by difficulty of drainage, but the operation should be confined to a plane section in the infected joint. The final plastic restoration should be delayed for several weeks, this facilitating an economical operation. As much of the calcaneum as possible should be preserved. The writer approves of the Pirogoff operation, with or without modifications. Quénu (*Bull. et mém. de la Soc. de chir. de Paris*, xlii, 538, 1916)).

KINEPLASTIC AMPUTATIONS.

The great war has greatly modified the attitude of surgeons in respect to the indications for amputations, owing mainly to the advances in plastic surgery. As emphasized by J. P. Warbasse (*Amer. Jour. of Surgery*, June, 1919) the advancements of plastic surgery have made new conceptions possible. Moreover, amputations can no longer be reduced to a matter of rules. Rare judgment is required in determining when, how or where to amputate, with the question "Is amputation required at all" as the predominant one. Once the general question determined, a plastic operation should be preferred to lopping off a limb. Warbasse urges, as a conclusion taught by the war, that "*if there is living tissue beyond the proposed place of amputation, the necessity for the operation should be questioned*," while the possibility of plastic surgery is now so great that before operating the surgeon should ask himself: "*Can I not excise the diseased part and supply the deficiency by grafting*?" Bones, skin, muscle, tendons, fascia, blood-vessels, nerves and joints are all capable of restoration and grafting.

As Warbasse further states: "It should be borne in mind that when a limb is amputated for disease other than gangrene, the blood supply is usually more than adequate to nourish the stump. It is adapted to nourish not only the stump but all of that part beyond, which has been removed. For this reason the transverse or flapless operation is to be considered always; and the covering of the bone end undertaken with a transplanted flap of skin. In uninfected cases the transplantation may be

done at once. In infected cases it may be undertaken later. . . . Rarely is it necessary to make a finished operation at the first setting. To save as much tissue as possible is usually a good rule to follow. Moreover, the surgeon should remember that the higher the operation the greater the shock. A few centimeters one way or the other may determine the difference between life and death. . . . While the typical methods of amputation are found described in text books on surgery (also in the foregoing pages), the surgeon should ever have in mind the lessons to be found in plastic surgery and the grafting of tissues, and make his own variations to suit the circumstances of each individual case and his own skill."

History and Definition.—Kineplastic amputations were first described and proposed by Giuliano Vanghetti, an Italian practitioner, in 1896 under the name of **cinematic amputation**. Not being a surgical specialist, his views attracted but little attention from European and American surgeons, and the number of kineplastic amputations performed before the recent war hardly exceeded twenty. And yet surgeons would all have agreed with Bernard (*Progrès Médical*, Oct. 19, 1918) when he declared that "it ranks among the greatest discoveries of orthopedic surgery," and that "it should be accepted with entire confidence and applied on a large scale to restore the functional use of limbs to the maimed."

The main aim is to utilize stumps which hitherto were deemed useless,—the carpal stumps, the very short forearm stumps, or disarticulation stumps, for example. Thus after preparing suitable points of attachment, the kineplastic surgeon will spare, for instance, the deltoid and pectoralis major in a shoulder disarticulation, cover these muscles with skin and endow the otherwise useless stump with most useful motion.

Vanghetti has also given the names **cinematic plastics** or **cinematics** to plastic operations that tend to economize, restore, or substitute muscular masses, in order to endow an artificial limb with voluntary motion.

This author had found that the muscles of an amputated member, when properly cov-

ered with skin and protected from retraction, could preserve their function.

General Technique.—All movable structure utilized in the reparative process, muscle tendon, etc., is termed a *plastic motor*. Its use is based on the following principles: In an amputation or disarticulation, the tendon and muscles, if protected with skin, vessels, nerves, etc., can generally be used if it is possible to provide a suitable point of attachment, similarly protected. This can be carried out either at the time of the amputation, or on healed stumps. The most commonly employed plastic motors are the *peg* (*clava*), the *loop* (*ansa*), the *knob*, and the *loop knob*. While the two first terms are self-explanatory, the "knob" is a thickened mass formed on the extremity of muscles, tendons, or aponeuroses and upon which some fixture or ring may be attached to exercise traction upon the prosthetic apparatus.

A plastic motor may be terminal, lateral or extra-segmental in its relations to the stump and its attachment thereto. Again, plastic motors may be unimotor or plurimotor. Thus, if there are two muscles with possibly antagonistic actions united in a loop or knob, a double alternative movement may be communicated to the prosthetic apparatus from a single point of attachment. Vanghetti (*Arch. méd., belges*, lxxi, 633, 1918) regards the alternating tendon and aponeurotic loop as the ideal motor. The same author (*Chir. degli Organi di Mov.*, I, No. 1, 1917) states also that given two muscles with the possibility of reciprocal antagonistic action, united to form a loop which can slide on a support communicating with the prosthesis, a dual alternating motion can be imparted to the prosthesis by means of only one point of connection. Again, a loop formed of two smaller alternating loops, interlocking like the links of a chain, may be able to impart three sets of movements to the prosthesis by the four muscles and three points of connection.

Where, as in first aid dressing stations, during the stress of battle, it is virtually impossible to perform primary plastic operations, the surgeon can nevertheless prepare the ground for the procedure. Thus skin flaps, muscular insertions, vari-

ous bone and tendon fragments and segments of limb, which would seem superfluous under ordinary circumstances for the preparation of ordinary stumps, must be recognized to be of the greatest value in view of future kineplastics.

As emphasized by V. Putti (Lancet, June 8, 1918) there must be preserved the greatest possible amount of bone as well as the motor masses and integument. Skin flaps, muscular insertions, various bony and tendinous fragments which would seem utterly superfluous under ordinary circumstances for the preparation of ordinary stumps are to be considered of the greatest value in kineplastics. Retraction of the softer tissues must be guarded against so that a subsequent application of the principle may be successfully carried out.

A motor flap must (1) possess every requisite for withstanding a firm, resisting and painless grip, also a traction that sometimes attains a high degree; and (2) it must be provided with a sufficient amount of functional muscular tissue to guarantee the accomplishment of the task that will be demanded of it. The flap must be covered with skin in perfect condition, well nourished, and provided with a normal degree of sensibility. It must also be of suitable size for the fastening of hooks, wings, and rods that are destined to transmit the functional movement of the artificial limb. As the tendon is the element best adapted for the transmission of the muscular contractions, it must be largely used for the formation of the terminal motor flaps, or by tunnelizing the muscular masses extraterminal motors are formed.

In order to supply such materials as may be missing *in loco* recourse may be had to the numerous methods of transplantation of skin, muscle, aponeurosis, or bone. Arthroplastics, with interposition of aponeurotic flaps, may render stiff and ankylosed stumps usable. The difficult prosthetic problem of gaining power over the knee-joint has been solved by successful kinematization of the quadriceps; also the carpal stumps, the very short forearm stumps, and the disarticulation stumps are capable of good functional movements due to kineplastics.

The action of the flexor and extensor muscles of the forearm may be transmitted to the artificial limb by means of metal rings covered with vulcanized rubber. These are placed at the ends of the finger-like motor flaps and gradually tightened until held firmly, to which the fingers of the artificial hand are attached. In another type of motor flap the tendons of the flexor and extensor muscles are brought together in such a manner as to form a ring or loop which is covered with skin, through which a rod is placed to be attached to the artificial limb. Experience has proved that if the motor flap is well placed, if the skin that covers it is healthy, and if the wounds are absolutely healed, neither the rings nor the rod cause the slightest pain nor do the least harm. The ring is supplied with a screw by which the injured man may regulate the pressure on his finger-like motor flap. The rod should be removed at least once in twenty-four hours in order to clean it with alcohol and lubricate it with vaseline.

The sensibility and muscle sense of the flap when first made is greatly impaired but improves upon use until even a keener sense than normal is developed. The patients best adapted for this class of procedure are those between 20 and 30 years of age, who are intellectually keen, and adapt themselves to their newly formed members. Diligent training is required to cultivate the muscles to accurately and untiringly take up their new work. It is essential that the artificial limb be suitable for the stump and for the work demanded of it.

To revivify the muscles of a stump and train the motor centers to a peripheral action and kinetic play which is fundamentally different from the normal, appears difficult, but experience has shown that the resources of a muscle are infinite, both biologically and mechanically, and its motor centers are adaptable, while the resources of physiotherapy revivify and intensify the motor force of the stump. Study of the motor capacity of 200 amputation stumps compared to the length of the stump, showed that with the longer stumps the sacrifice of a few more centimeters of the

bone does not modify the motor power. The man must be able to rotate the limb. No attempt is made at reunion of the stumps of the tendons. The men soon learn to do separately the movements for bending and stretching the muscles. One man rapidly learned to bend the motor loop laterally (radial), the impulse, he said, being the same as for abduction of the limb. Putti (*Chir. degli Org. di Mov.*, Dec., 1917).

Kinetic plastics was resorted to by the writer in the case of a girl of 16 in whom, owing to congenital deformity, the left forearm consisted of but a short, though highly sensitive stump. By utilizing both the elbow joint and the muscles, artificial fingers became so efficient that she became self-supporting as a seamstress. Hoessly (*Correspbl. f. schweizer Aerzte*, Apr. 27, 1918).

RESORCIN.—Resorcin (*Resorcinol*, U. S. P.; metadihydroxybenzene) is a diatomic phenol obtained from metabenzene disulphonate by sodium hydrate with heat. It is also produced from different resins and from umbelliferous gum-resins on fusion with caustic potash. It is isomeric with pyrocatechin hydroquinone. It occurs in small, colorless, rhombic prisms, or plates, which turn reddish on exposure; is neutral in reaction; has a sweetish, unpleasant taste, and a peculiar but faint odor, which resembles that of carbolic acid. Its incompatibles are: acetanilid, albumin, alkalies, antipyrin, camphor, euphrin, exalgin, ferric chloride, menthol, spirit of nitrous ether, and urethane.

PREPARATIONS AND DOSE.—It is soluble in alcohol (1 in 0.5), in water (1 in 0.6), in ether, and in glycerin, but very slightly soluble in chloroform or in carbon disulphide. The best vehicles for medicinal purposes are alcohol, glycerin, and syrup of orange. Resorcin has antipyretic, antiseptic, antispasmodic, antiemetic, analgesic, hemostatic, and antizymotic properties. It is given in doses of from 2 to 10 grains (0.12 to 0.65 Gm.), several times a day; as an antipyretic, 15 to 30 grains (1 to 2 Gm.).

Resorcin is, in addition, used externally in a 1 to 5 per cent. solution or ointment.

POISONING BY RESORCIN.—In large doses (60 grains—4 Gm.) resorcin causes a lowering of the temperature (which persists for two or three hours), nausea, oppression, languor, salivation and profuse sweating. In larger doses it is followed by cerebral symptoms, such as giddiness, tingling, deafness, confused vision, tremor, clonic convulsions, and unconsciousness; the tongue is dry, the teeth clenched, the pupils normal, the temperature low, and the urine black (hemoglobinuria). Death occurs from respiratory and cardiac paralysis. Death has occurred in children from lavage of the stomach with a 3 per cent. solution. Schwabe recently reported a case in a child in which 15 grains in an enema produced alarming symptoms. In the adult recovery has followed the ingestion of 2 drams.

Cases have been reported where poisoning has occurred by the absorption through the skin. When large areas of broken or denuded skin are present, its use should be entirely avoided, especially in weak individuals and in small children.

Treatment of Poisoning by Resorcin.—Evacuation and lavage of the stomach are indicated. The administration of albumin, diffusible stimulants, and diuretics may be supplemented by the application of external warmth to the trunk and extremities. The use of atropine, strychnine, or ether hypodermically and of amyl nitrite by inhalation or internally will counteract the paralyzing effect of resorcin upon the heart and the respiration. Red wine has been suggested as being useful in these cases. When the drug is used continuously for a long time, it is wise to prescribe, internally, hydrochloric acid, which Unna recommends as the best antidote in phenol poisoning.

THERAPEUTICS.—Resorcin has been employed in doses of from 1 to 2½ grains (0.06 to 0.16 Gm.), in solution or powder, repeated every hour or two, for the relief of vomiting and seasickness. In similar cases it has been found of value in dyspepsia, chronic gastric catarrh, diarrhea, cholera nostras, cholera morbus,

and in **enteritis**. It is also serviceable in **enterocolitis** or **cholera infantum**. It relieves pain and checks hemorrhage from **gastric ulcers**. Gastralgia is relieved by this remedy.

Resorcin has been useful in **pertussis** and **hay fever**, in the form of a spray from a 2 per cent. solution and internally in doses of 10 drops of the same solution.

In a 2 per cent. solution, it is a beneficial application to **tuberculous lesions of the larynx**, and in **purulent and ulcerative affections of the throat and nose**; in the nose the solution should not be stronger than 1 per cent. In **diphtheria** resorcin is a valuable topical remedy. In **asthma** and **emphysema** resorcin has been given in doses of from 5 to 15 grains (0.3 to 1 Gm.).

Resorcin has been used topically in **skin affections of a subacute or chronic character**, in solution or ointment varying in strength from 1 to 10 per cent. or more. It should be borne in mind that weak solutions (1 to 3 per cent.) harden the skin, while stronger ones (10 to 50 per cent.) macerate and destroy it.

In **chancroids**, **painful ulcers**, and **suppurating and sloughing wounds** resorcin may be used externally in solution or ointment (1 to 10 per cent.), in injection or spray. Absorbent cotton and gauze may be medicated with resorcin for **surgical dressings**.

In **aphthæ**, **stomatitis**, and **thrush**, a 1 or 2 per cent. watery solution of resorcin is an efficient application. W.

REST CURE.—DEFINITION.—

The Weir Mitchell treatment by rest, isolation, and forced feeding is a radical and rational measure combining the fundamental desiderata for restoring exhaustion states.

[The system, viewed as a whole, is applicable to the repair of pronounced degrees of depleted vitality caused by a large variety of causal agencies. A personal experience of many years as assistant and later chief of clinic to Weir Mitchell, enables me to speak with confidence and knowledge of his methods and results. Doubtless his extraordinary personality, penetration, judgment, and clinical skill

all contributed to his brilliant successes. He devised and used it in combination with remedial agencies which in many instances proved the point of departure toward recovery of a multitude of heretofore baffling or incurable conditions.

The utility of rest treatment is to be evaluated not so much upon the reasonableness of mere rest, isolation and forced feeding as upon collateral factors differing with each case. These are ever the same in principle, but vary with circumstances under which the process is begun, and the amount of authority permitted the physician for the exercise of control over the patient. Above all, final success cannot be expected unless caution is exercised in slowly but judiciously restoring customary activities and responsibilities. J. MADISON TAYLOR.]

Among the factors in a full course of rest treatment are all those agencies which contribute to what may be termed reconstructive personal hygiene. This includes full physical and mental relaxation, all those measures of revised life and conduct which make for improved nutrition and elimination, and, finally, education in constructive activities.

The process is one of education, training and retraining of the body and mind. Hence, in the training of the body attention is given to various organs and systems, *e.g.*, the respiratory, the digestive, the sense organs, the skin, the skeletal structures, joints, etc. Many individuals, as clinicians well know, are ignorant of the essential principles of mental and bodily hygiene. This is just as true of those amply supplied with luxuries as those who are deprived of them.

Discipline, concrete guidance, enforced attention upon the need of normal function and its regulation can be especially well supplied while the individual is removed from dis-

tractions of every-day life, personal demands and habits.

[Isolation and enforced submission provide the physician advantageous opportunities for thoroughly exploring each and every point and symptom, whether conscious or submerged, and for estimating their significance and limitations. Many of the sensory distresses are evanescent and negligible; others are of grave import, though suppressed or below the threshold of consciousness. Among the manifold phenomena deserving critical attention are: abnormal subjective and objective sensations; paresthesias, of pressure, constriction, numbness, tingling; of varieties of headaches, backaches; sense-organ anomalies, visual, auditory, tactile, and olfactory; spinal and other tender-nesses, backaches, derangements of secretory and sexual organs; abnormalities of motion, direction, of power or weakness, local or general, cardiovascular, renal, and endless others.

Physicians often urge objections to the rest treatment which are erroneous or fanciful; or cite instances where no good was accomplished by it, or where actual harm is charged. This opposition is due to insufficient knowledge of the true purposes and procedures, or to a lack of persistence in enforcing them. Where suitable cases present, and it is decided to employ the measure, there are usually strong objections urged by the patient against such long and radical procedures. In consequence of this the temptation is for the medical adviser to so modify essential steps, in the endeavor to please patient and family, that it fails to supply definite needs, which may be clear to the physician, but not to the ailing person. Where protracted disabilities have induced that mental confusion and misinterpretation of symptoms, which inevitably follow from hope long deferred, much suffering and disturbance of customary habits, then the one quality a physician must display is decision, determining what is best and unfalteringly pursuing his plans to a successful issue. He should decide and execute.

There should be no greater difficulty in pursuing a course of rest treatment than

in any other logical or rational measure. One can always accomplish by it far more prompt, uniform and permanent results, than by a course at some foreign spa or by haphazard travels, and it is more creditable to the physician. J. MADISON TAYLOR.]

The chief features of rest treatment submitted here are from the standpoint of one long familiar with its features and possibilities, and should furnish the general practitioner with confidence in rendering more available this excellent form of systematic therapeutics.

Accuracy of diagnosis is requisite in dealing with any derangement; it is pre-eminently necessary that the physician shall have adequate time and opportunity to study those complex problems involved in the neuropathies, neurasthenias and psychoneuroses. In by far the largest proportion of those who have suffered from protracted ailments or illnesses, there has arisen an involved mental state compounded of real and unreal phenomena. The solution can then only be reached by a nice degree of awareness in which psychology is on a par with the utmost scientific resources of purely medicinal measures.

The most efficacious means of securing a state of physiologic receptivity, both for psychic and physical adjustment, is to **place the sufferer at absolute rest, to seclude from all outside influences, family, mail, news, and the like.** Under no consideration should this be attempted in the patient's own home if psychopathy be a pronounced feature. Mere physical rest, moreover, is frequently not enough. Hence Weir Mitchell initiated and developed a systematic method of what he describes as "robbing rest of its evils;" nay,

more, to so enhance its value by suitable coefficients as to bring about permanent betterments. Rest is an obstacle to further improvement if continued beyond its useful period. Excessive rest leads to degeneration of tissues; not to restitution.

The central point of the rest treatment is the analysis of morbid phenomena, physical and mental, reinforced by dominant, educative suggestion, "moral orthopedia" (Dubois), a wise training of the patient, whose salient characteristics are maladaptation between his own consciousness and environment and impairment in powers of right thinking, willing, feeling, and doing.

Not all cases of psychopathy or psychasthenia need rest treatment, but isolation, like "moving the previous question," cuts off debate, places the individual in the "hypnotoidal state," which, by eliminating the life of customary relationships, enhances receptivity not only of mind but of body.

By absolute rest, isolation, and forced and regulated feeding, one can best plow and harrow the ground, enrich the soil, and then proceed to sow the seeds of right thinking, feeling, willing, and acting. This is the key to the situation: to place the psychically entangled individual, whose central defect is weakness, or exhaustion, or both, in the best possible attitude for educative suggestion and bodily repair. Time, abundant time, is required, with ample opportunity to slowly but surely conserve the budding growths of vigor and wholesome-mindedness.

He who gets well the soonest and remains permanently cured is always the most obedient, the most coadjuv-

ant. When dissociation or disintegration of personality is redisintegrated, the psychic instability corrected, the infinite changeability mitigated, the fundamental physiologic functions restored to a normal rhythm, one can then proceed confidently to overcome the abnormal fatigability and other neurasthenic substrata. If the getting of a patient to bed is not easy, as often happens, the resumption of activities after some weeks is no light problem; that is, to do so safely and permanently. To restore is only the beginning; to reinstate volition, to make sure of progressive efficiency, is the real object.

Among the chief agencies of the after-cure in rest treatment are motor education and persistence in right doing. Both motor and psychic right direction in the months and years to come is of more real importance than even the preliminary, though radical measures. Here the counsellor shall stand or fall, according to his judgment, his personality, his persistence.

OUTLINE OF THE DAILY ROUTINE.—The patient who requires the rest treatment is no longer in a position to drive his business, whatever it may be, but, being unable to do so, the business drives him. So long as the ship is under way and proceeding by its ordinary motor forces, it can be steered satisfactorily. If the driving forces become too strong so that the capacity for guidance is lost, the ship can no longer be accurately directed, becomes buffeted and in danger from misdirection. Again, unless the various measures follow in regular progression the same results cannot be expected, because, if for no other reason, it is an

expensive process, on account of the time lost.

The best results are had from modeling the day much after that of an ordinary working person. Measures should begin early in the morning. The patient usually needs to be aroused at about 7 o'clock or even earlier in summer weather. With the first peep of dawn, if the patient is awake, or by 7 o'clock at the latest, when, if asleep, the patient should be awakened, the nurse should bring some hot drink to the bedside. A small cup of cocoa is in some respects the best; or hot milk or weak coffee or tea. Cocoa is useful for those who need to be fattened; tea better for those who are already burdened with soft flesh. The hot drink acts both as a food, enabling the patient to bear the fatigues of the subsequent bathing and toilette, and also, on account of the heat, as an admirable heart stimulant. Indeed, a cup of hot water in the morning is a far more competent "eye-opener" than any combination of alcohol. This can be proven in the case of men accustomed to take much tippie, who often become more enamored of a cup of hot water than of any concoction emanating from a bar.

After a cup of hot fluid, the nurse administers a brisk dry rub or a bath. A sponge bath is best as cool as possible; to those who can endure it, it should be cold. It is better also for containing some stimulating property, as salt. The patient lying between blankets to prevent all chill, the nurse takes one limb at a time, bathes it gently, and afterward rubs the skin to a good pink glow. As each part is disposed of it is carefully protected by a blanket, and the next ap-

proached. This occupies probably half an hour; then a rearrangement of clothing, and the subject is made comfortable for the day.

About 8 o'clock comes an ample breakfast, which will be found in no way interfered with by the small cup of drink earlier. After breakfast an hour's rest follows while the nurse attends to duties elsewhere, and the patient is not allowed to be disturbed. The second meal is given about 1 o'clock, and takes the form of a liberal dinner. At 6 o'clock comes the last meal, a fairly substantial supper. After each meal a period of an hour should elapse in which the patient is to be kept entirely quiet. Between breakfast and dinner, about half-past 10, fluid food is again given—milk, broth, or soup. In some cases this is repeated between dinner and supper; and at 9 o'clock, or before the final tucking in for the night, it is customary to give again a glass of milk, preferably warmed.

The massage should come either in the morning, just before the milk, or in the afternoon, midway between the meals. If electricity be used at all, it may be applied in the course of the half of the day not occupied by massage.

On going to bed at night there is frequently given a dry skin rub with a coarse towel, or, if salt is not used in the water in the morning bath, with what is called a salt towel. This consists of a coarse cloth dipped in a strong salt solution and dried; it is stimulating to a flabby skin. Massage is best used in the morning, and is followed by a glass of milk, the patient again lying quiet for an hour. Electricity is best given in the afternoon, and need not be followed by

anything except, perhaps, cheerful conversation. Indeed, the physician's visit is most acceptable during the latter half of the day, when occupations are somewhat less systematic and the diurnal ebb and flow of vital forces are at their lowest. The patient is then most lonesome; thoughts dwell upon home and other emotional matters, so that the physician is welcomed in turning aside discomforting ideas. The electricity need not occupy more than half an hour, making an agreeable break in the day's work. This may be administered by a young physician trained for the purpose, or, in some instances, by the nurse; but it is oftentimes of distinct value to use a variety of personalities in performing these routine measures.

The daily evacuations should be sedulously regulated. It is well to follow the habits of each one as to customary time of the bowel movement. However, a full daily evacuation of the bowels should take place at some regular time, and the will of the individual should be trained to bring this inevitably to pass. The patient gets up for defecation. Slow-acting bowels act best in a stooping posture, squatting on the heels over a shallow vessel.

Not the least factor of value in this whole episode is **the establishment of thorough, systematic habits of body and mind.** At first there should be entire dependence upon the attendants; later, as active measures are instituted, the patient should be taught to direct her own volition in entering into the spirit of various measures; must soon or late depend upon herself to continue. Urination must be supervised, its quality and quantity

carefully noted; fixed times for the voidance of the urine are most useful.

Body temperature should be taken regularly, at least twice daily, to observe fluctuations and unknown tendencies. It will often be found about 100° F. (37.7° C.) for two or three days; then it may drop to subnormal for a few days more, and finally become and remain normal.

DIET.—So well is the subject of dietetics now ventilated, that it is only necessary here to remark that while particularized dietetics is a most important factor in the treatment of exhaustion states, it is not so paramount as some have claimed. How one eats is often of greater significance than what. Mastication is of first importance; omitting to sip fluids is another. Motor power of the stomach is above biochemical regulation. Where the patient is undernourished full feeding, even forced feeding, is indicated. Milk and eggs, especially the raw yolk of eggs, should be administered between meals. Where there is obstinate dyspepsia, or, as occasionally happens, overweight, or hypernutrition, a course of skim milk in lessening amounts, after the method of Karrell, will prove of advantage to reduce flesh, relieve vascular tension, and cure many functional derangements. This consists of eight ounces of skim milk, sipped from a spoon, every three hours, each day lessening by one ounce, till only two are given, then increasing to the first amount and gradually adding some stewed fruit and bread, then in about three or four weeks getting back through a simplified, to a more complex, and finally to a normal dietary. A period of complete starvation any time for a

day or many days is an excellent device to correct vitiated digestive states, gouty phenomena, hypochondriasis, or to restore lost appetite. While a person is at absolute rest many such radical measures can be employed more safely and successfully than for one who is up and about. Moreover, hyperalimentation can then be pushed to an extraordinary degree. Full and overfeeding to the limit of capacity is paramount to make up for lost nutritive balance.

Hastily accumulated fat is readily lost. So are other rapidly stored cells in danger of swift escape when activities are resumed. Hence the necessity for those rational auxiliary measures, massage and graduated forms of motor education not only to hold what is gained, but to render it available, useful, potential. Nutritional errors met are largely due to impairment of innervation from exhaustion; hence the need of rest which usually is in itself adequate to restore digestive tone.

MEDICINES.—A good clinician can be safely entrusted with the administration of needful drugs, and he is the more successful when working with such tools as are familiar. Few are needed; this elaborate process of nutritional repair renders them relatively unnecessary.

In this connection it is well to refer to the suggestive summarization of the pathology of neurasthenia as presented by Sajous. Neurasthenia is recognized to be a vasomotor neurosis, the prominent feature of which is relaxation of all arteries. This he explains as due mainly to exhaustion of the sympathetic center and the resulting relaxation and loss of propulsive power of the arterioles. The tissues

thus become imperfectly oxygenized and nourished; hence follow the mental torpor, habitual fatigue, adynamia, and gastrointestinal atony. Various clinical classifications are suggested, describing varieties of functional disturbance; but whatever the multitudinous symptoms, certain features are common to all which depend on varying degrees of hypothyroidism. Hence he recommends small doses of desiccated thyroid, and usually in combination with small doses of strychnia and full amounts of an assimilable form of iron, such as Blaud's pill. These produce an improved tone and nutritional power of the blood. The thyroid preparation is assisted by strychnia, which, by exciting the adrenal and vasomotor centers, enhances general oxidation and the vascular tone. The sympathetic center and muscular layers of the arterioles are also better nourished, and they recover tone from another direction, a most important factor in systematic repair.

MASSAGE, PASSIVE AND ACTIVE; EDUCATIONAL MOVEMENTS.—The efficacy of massage is so great that it is surprising to hear the measure occasionally belittled. Few clinicians practically study the subject and hence are victimized by inferior operators who, failing to get adequate guidance and direction, produce valueless or even hurtful effects. Suffice it is to say that while aiming to improve both psychical and physical conditions, we have a powerful ally in judicious manual methods of awakening the dormant kinesthetic centers by motor and sensory stimulation. It is most necessary, in treating the victims of disuse or misuse of bodily and mental function, to re-

store normality in the realm of both correct sensation and motion. Receptive centers have here become dormant, vitiated, or exhausted; the cortical sensory and motor centers need to be brought into normal relation with the rest of the controlling centers, hence with the whole field of consciousness.

The sensations and ideas of motion are functions of the convolutions back of the Rolandic fissure. In normal volition these convolutions are first excited by association impulses from other centers, and then directly or indirectly by association impulses which they arouse in corresponding motor centers in the precentral convolutions.

Furthermore, above and beyond effects to be achieved by general massage and regulated (passive and active) movements, there is a vast field of potentiality in judicious nerve-pressure, direct, distributed and alternated, whereby extraordinary effects can be wrought in regulating vasomotor reflexes; hence on blood distribution, etc. This last is rightly the province of the skilled physician and should be performed by him, or, at least, under his direct supervision.

The enforced inaction continued through many weeks would produce objectionable effects unless something definite were done to rob rest of certain evils. The most important agency for this is to employ regularly a generalized massage or manipulation of the muscles and tissues, by which they can be maintained in a healthy condition until the period arrives when active muscular movements can be resumed. If this were not done, as a rule there would be too great a gain in flesh, chiefly fat,

but all the cellular accumulation would be loosely organized and unstable. An index of the good which the rest treatment is accomplishing is a normal progress in the accumulation of weight which should be not too swift. It is an axiom that poor massage is better than none at all, but by this is meant lack of skill in the manipulations failing to bring about the best results; it does not mean overzealous or forceful manipulations, which may, and sometimes do, result in harm. A fair index of the value of the massage is the equation between the amount of food taken and quality of the digestion. It should produce a proper amount of tissue change and waste by which the solidity of the tissue is improved. In my opinion, it is impossible to do without any massage and get satisfactory results. Physicians will soon realize that one of the largest factors in therapeutics is mechanical excitation of nervous control mechanisms.

It may be we shall always employ for the routine procedure of passive exercise a special expert in massage and remedial movements; but in order to get best results, the medical adviser must himself clearly understand his physiology, and the enormous possibilities of mechanical excitation of centers.

It is well to bear in mind also, that for very feeble patients massage is capable of producing fatiguing effects of a somewhat serious nature, even if the methods employed are excellent. When it is held in mind that undue pressure upon certain areas produce powerful effects upon arteriomotor innervation the physician at least must be on his guard to warn the operator how to avoid this.

Massage as used in routine procedures is usually given in the middle of the forenoon, and the electricity in the middle of the afternoon, or this may be reversed. At first the time occupied should not be over twenty or thirty minutes and by a slow, gentle effleurage with passive movements of the joints. At first the manipulations should be stroking, then kneading in character, and gradually increased until the upper tissues are made to act upon the lower, until the deepest tissues are reached, pulled, and stretched. As the patient becomes accustomed to this, in a week or ten days deep kneading is used, increasing the force until all the muscle-masses are squeezed and relaxed, and the long tendons pulled upon and rotated without pain. This should always result in a feeling of comfort and satisfaction akin to that which follows active exercise. Massage under these circumstances is chiefly for the purpose of affording a passive form of exercise which the condition of the patient would not warrant, and it is generally accepted that a full hour's massage treatment is equivalent to an active walk of five miles. This brings no strain upon the heart or the central control mechanism and hence does not fatigue either the circulation or the attention. As the treatment progresses the massage proper can be more quickly and forcefully accomplished, and passive movements of the limbs are more thoroughly used until considerable force is exerted on the tendons and ligaments by which the joints, both large and small, are kept in full elasticity and tone.

Toward the end of the treatment, it may be six to ten weeks, accord-

ing to the strength of the patient, forceful resisting movements are practised. By these the entire motor mechanism is brought into play and physical vigor is oftentimes made to become as good as it was under normal conditions. Then this is supplemented by fuller regulated activities until it is not rare to find that a patient subjected to this routine can be brought to a degree of physical efficiency which she has never expected to enjoy. More and better effects can be wrought upon bodily powers by these systematized remedial movements, if the patient judiciously cooperates, than can be accomplished by any amount of undirected free exercises.

Certain precautions must be maintained. The tissue should become thoroughly relaxed while passive movements are employed. During active processes fullest accuracy and force should be elicited in not only posturing movements, but especially during resistance. Resistance movements are best slow, but of increasing-force to a point where movement is completed and the limb held in utmost tension capable for a few seconds. Extensor movements in the arms are more important than the flexor, because most common daily acts are flexor movements, and an excess of extensor movements is needed to acquire free muscular power. Only through thoroughly directed and accurate muscular actions can the circulatory machinery be kept at its full efficiency. Only through circulatory activity can nutrition be fully maintained. Only through fullest nutritive interchanges can exhausted nerve-centers regain tone.

During massage, relaxation of su-

perforated capillaries and opening of sweat-glands occur. This relaxation is followed by surface moisture which, by evaporation, induces escape of heat, producing surface chill, and ill-effects follow to be guarded against by a careful protection of the part. Each part should be wrapped after being treated, on woolen stockings slipped over legs and arms. Rest for a full hour follows.

For those not fully strong a period of rest should supplement that of activity, and for the same length of time. To sum up: The procedures of massage, passive exercises, resistance movements and active movements, should be systematically increased in proportion to the strength of the individual. Surprising results will then follow.

THE NURSE.—Next to wisdom and tact in the physician, is suitability of the nurse. Not only must she qualify technically, but intellectually, and in the realm of common sense. Her business is to maintain a symmetrical, consistent, daily routine, and keep the patient busy all the time, supplying just enough conversation, but not too much information or explanation. Patients often remark that the rest treatment was one of the busiest periods of their lives. All this keeping busy is essential. The patient is, and should be, passive, in extreme cases absolutely so, all "doings" being performed by others. At first the nurse actually places food in the patient's mouth. Conversation had best be of the simplest. Part, and not the least part, of the cure is selection of judicious topics; their character and manner of presentation is the duty of the nurse from hints supplied by the physician.

Old lines of thought need to be firmly set aside and new points of view presented. Suggestive education is paramount. In this the nurse is the constant, if not the chief, agent.

Upon the nurse depends success or failure. She must be the right hand of the physician; to her must be explained precisely what is expected. For her must be outlined the whole status of the case and the peculiarities of the individual. She should be selected by the physician and never by the patient. The nurse that brings a patient from a distance, or has been in previous attendance, if a stranger to the physician, is valueless; at least, if the case be difficult psychically. No amateur nurse, however wise and capable, can be depended upon. Relatives and friends are useless and worse than useless. The nurse should be a stranger to the patient and, if possible, have had some experience in similar cases. However, a young, intelligent and enthusiastic nurse can be taught readily to become invaluable; an old experienced nurse, whose gravity has matured and whose enthusiasms have cooled, is not so good. The neurasthenic, or hysteric, or hypochondriac, or that complex blend which usually demands this sort of care, will inevitably try the patience of a very angel.

The nurse must occasionally be changed, but not too readily, because it is a hard matter to judge fairly upon the patient's representations. If, however, complaints are seemingly well founded, this may be necessary. It should not be done too often or worse will follow. It is not necessary that nurse and patient have similar tastes and interests; it is bet-

ter they should differ in education, religion, or capabilities. It may be important to act upon the patient through the nurse by marking out a line of fit conversation which can only thus be carried out, and may stimulate other thoughts, and to better conclusions. The nurse should be warned against discussing symptoms or the wisdom of certain procedures. She must be sympathetic, but should not sympathize.

When the physician has made his visit, it is well for the nurse to make her report before the patient and then to leave the room. Thus the patient may unburden herself of any matters without an audience other than her appointed confessor.

After completion of treatment it is customary to send the patient, with her nurse, to some pleasant place in the country, or quiet seaside or mountain resort and pursue an after-cure. Then the need of a wise nurse is often greater than before; her qualities are more critically tested. If she be refined, she should travel as a companion, and not be obviously a care-taker. If she has some artistic accomplishments, or abilities to ride or drive, she is thus of special companionability; familiarity with the various fields of sports is to be appreciated.

Sometimes nurses accompany patients in foreign countries and for long periods; then special qualifications are needed,—above all, self-reliance and generalship. It is often necessary to instruct a nurse to exhibit, after a time in a foreign country, a degree of helplessness which shall compel the patient to take charge as courier, and regain her own lost dominance. A patient who was

becoming very dependent upon her nurse, in all the attitudes of life, found herself in difficulties which proved to be most fortunate. Falling seriously ill, the patient had to look out for her, and this solicitude was the means of herself regaining certain qualities which almost nothing else could have effected. It is a rule to change a nurse in about two or three months. Few can be trusted to remain longer. The reasons for this are manifold, as experience will show.

In some cases early, and in others late, the nurse is allowed to read from some interesting book, for a specified time, once or twice a day. The character of this reading should be carefully selected. The best is the simple mental pabula of childhood, as classical fairy tales and ancient romances. Many a patient has expressed satisfaction at the opportunity offered of renewing acquaintance with these delightful Old World romances.

CONVALESCENCE AND AFTER-CURES.—Lack of space forbids more than brief reference to what Dr. Mitchell always emphasized as the most important part of the rest treatment, viz., adequate control and supervision till the cure becomes permanent, or as nearly complete as under existing conditions could be achieved.

Rest treatment is a systematic process of regeneration or restitution, the aim being to not only restore health, efficiency, self-control, physical, mental, and moral equipoise, but also to retain all that should be gained till the end of life.

Hence, consistency of measures, as has been so often repeated, is of paramount necessity. The means

which he employed embraced all those agencies which could be elicited to impress the consciousness of the patient with his or her highest duties to self. It is also a process of training or retraining, of dominant guidance, of securing full co-operation after having raised the index of efficiency through awakening sense of duty to highest standards of conduct.

Dr. Mitchell was peculiarly fitted to arouse ambition, to conserve personality as well as to reconstruct and equip the body for life's work, duties, and satisfactions.

The first steps after absolute supineness are those of getting the patient upon her feet. To be sure some rising and moving about are usually encouraged during the rest; often it is unwise to do so. Hence, getting up requires much urging, or cajoling, or domination. Many persons fiercely resent being disturbed, so serenely comfortable have they become, so resigned to complete dependence. The most difficult problems are persons who were most rebellious against going to bed.

Sitting up is begun by ten-minute periods, first once a day, then twice, then adding five minutes till an hour and a half, then walking to and from a chair and increasing the distance of the chair from the bed. Finally, an outing is planned—a drive or short walk.

All this should be accurately outlined and strictly carried out. Any sort or kind of excuse may be offered to break routine. Tact in the nurse is a great help; she should co-operate in spirit and letter. After the patient has left immediate supervision, the nurse reports regularly and fully; later the patient writes also at speci-

fied periods of weeks or months, and especially after the nurse has gone. This period—the final severing of personal contact—taxes the diplomacy of the patient and adviser.

Here some of the most fatal blunders are made. Other, alien influences are encountered. Mischief-makers are peculiarly eager to overthrow wholesome routine and break in on consistent measures. During my period of service as confidential secretary many vividly interesting and exciting occurrences arose, forming materials for books on psychopathology and anomalous human documents.

Such experiences were invaluable clinically and saved my making many serious mistakes, medical, psychological and domestic. Errors in this stage of procedure often cause ill-deserved blame to fall on the physician.

Finally, how long does it take to restore an exhausted human being? They must be managed with rare acumen and supplied with radical conservative procedures, for so long a time as is needed for cellular restitution. This, by common experience, takes at least half or a third of the time consumed in producing the effects, seldom less than from one to three years; about two years, as a rule.

The channels of guiding force demand skillful re-education. Where serious vitiation has occurred, not only in the physical but also in the psychic habitudes, there is also the problem of mental readjustment, and this is not only the more difficult, but also the more protracted.

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RESUSCITATION.—The respiratory process is often compromised or arrested by conditions which prevent the access of the oxygen of the air to the lungs: drowning, foreign bodies, throttling; irrespirable gases, such as illuminating gas, fire-damp, etc. Under these circumstances, artificial respiration is an extremely valuable procedure, when, of course, the cause of the asphyxiation has been removed. Foreign bodies interfering with respiration are sometimes difficult to reach, a laryngologist being often necessary; but frequently the object may be grasped by sweeping the lower pharynx with the index finger. The epiglottis can be raised by the same procedure. In drowned subjects, any water which has entered the lungs must be removed; the various methods available are described under "Drowning" in another volume.

TECHNIQUE.—The **Sylvester-Howard method** of artificial respiration is that now generally preferred. The patient's shoulders and chest are raised from the ground by placing a folded coat, a rolled blanket, or any other article at hand under the shoulders, the head being allowed to fall backward. If he is being anesthetized the patient is slid up on the table, the head allowed to hang partly over its edge, and the foot of the table raised. The physician, kneeling or standing at the patient's head and facing the latter, seizes his bent arms firmly at the elbows, and draws them outward and upward toward the head. This maneuver causes both the expansion of the chest, by raising its walls, and the entrance of air into the lungs. As it takes a second or two for the latter to become thoroughly filled, the arms are kept in the position mentioned that length of time. The elbows are then brought down again toward the chest, and, when the latter is reached, firm pressure is exerted (through the intermediary of the patient's elbows, of course) upon the ribs, so as to cause these to sink in, thus compressing the lungs and expelling the air. It is important in this connection, however, to have an assistant at the same time apply his hands over the lower ribs on each side and press them inward and upward, *i.e.*,

toward the diaphragm, thus further compressing the thorax, to force out the air. This complete cycle—expanding the chest and then compressing it—should be carried out deliberately and evenly about 16 to 18 times a minute—the normal respiratory rate.

This procedure is often successful in restoring life even when it has apparently been suspended some time; but it is important to persevere in the face of discouraging circumstances an hour or more. Slapping the patient's body or face with a towel wet in ice-water, or forcibly dilating the sphincter ani, sometimes hastens recovery by inducing sudden reflex inspiration.

Restoration of the respiratory function is indicated by a gradual disappearance of the pallor or lividity and of the cyanosis. With the return of color follow feeble gasps now and then, soon succeeded by stronger attempts at respiration with return of heart beat and pulse.

The **Schäfer method**, more recently introduced, is especially useful when the physician or operator is alone, because it enables him without assistance to exert considerable pressure upon the chest, to expel the air. Instead of being laid on his back, as in the foregoing procedure, the patient is laid in the prone position, *i.e.*, on his abdomen, the face being turned slightly to the side, and a folded garment or blanket is placed under his chest. The operator then kneels across or athwart the patient, facing his head, and applies his hands to the back, one on each side of the spinal column, spreading the fingers over the lower ribs. He now throws the weight of his body slowly upon the latter and the thorax, thus bringing about its contraction and expelling the air in the lungs. He then raises his body and relaxes the pressure, allowing the thorax to expand and to cause the air to enter the lungs. These two steps are executed repeatedly, with deliberation and regularity, 16 to 18 times a minute, as in the foregoing method.

The Sylvester-Howard method is preferable in that the stage of thoracic expansion is actively facilitated by raising the arms, whereas in the Schäfer method

this feature is left to the resiliency of the thorax. The chances of recovery may be greater, therefore, when the Sylvester-Howard method is employed. Moreover, the latter facilitates the use of a valuable auxiliary measure: the **Laborde tongue-traction method**, which consists in seizing the tip of the tongue with the napkin-covered fingers, and fully drawing out the organ, rhythmically, 16 times a minute. This procedure in itself, through excitation of the respiratory centers, is capable of restoring the breathing process in some cases, and thus constitutes a valuable adjunct to artificial respiration. The **intravenous use of warm saline solution** (105° F.) with 20 minims of 1:1000 **adrenalin chloride** solution added drop by drop to the saline solution (by sticking the needle of the hypodermic syringe into the rubber tube conveying the latter) is another potent aid—owing to its stimulating action on the cardiovascular mechanism.

At the meeting of the Resuscitation Commission held in New York on May 17, 1918, Professor Schäfer in a communication informed the members (Med. Record, Dec. 28, 1918) that "the prone [or Schäfer] method has been adopted *exclusively* for about 12 years by the Royal Life Saving Society, the only important organization in the British Empire whose object is the resuscitation of the apparently drowned. It has also been adopted for several years by the London and other police forces, by the Board of Trade, by the Army and the Navy. The most important thing is in cases of drowning to have something ready which any man can use; which will effect respiratory exchange—whether exactly as much as normal matters very little."

In the discussion following the presentation of methods and evidence to the commission the following facts were emphasized: (1) That in most accident cases no resuscitation apparatus was at hand

for immediate use. (2) That reliance upon the use of special apparatus diminished greatly the tendency to train persons in the manual methods and discouraged the prompt and persevering use of such methods. (3) That police officers or physicians often interfered with the proper execution of manual methods, in that they directed that the patient be removed in an ambulance to some hospital, thus interrupting the continuance of artificial respiration. (4) That in many hospitals the members of the staff were not all acquainted with the methods of artificial respiration. (5) That in medical schools instruction was not properly provided for students in the manual methods of artificial respiration.

In 2 patients an injection of 1 c.c. (16 minims) of **adrenalin** and 0.5 c.c. (8 minims) of **pituitrin** into the left ventricle a few minutes after the heart had stopped beating started the heart beat again, but both died within an hour. In a case of bullet wound of the heart a similar injection revived the heart and the patient seemed to be doing well until pericarditis proved fatal on the second day. The fourth patient had a severe contusion of the chest and upper abdomen. The heart stopped beating during an exploratory laparotomy and could not be revived by massage; 1.5 c.c. (24 minims) of a 1:1000 adrenalin solution were injected in the pericardium through the fourth interspace, inside the nipple line, to a depth of about 2 cm. The heart then began to beat again, and an intravenous injection of 700 c.c. (1½ pints) **salt solution** with 10 drops of **adrenalin** and 0.5 c.c. (8 minims) of **pituitrin** was made at once. This patient recovered. K. Henschen (Schweizer. med. Woch. Apr. 1, 1920). S.



